T 101: Searches/BSM VI

Time: Friday 9:00–10:30 Location: KH 02.018

T 101.1 Fri 9:00 KH 02.018

Search for X → HY production in bbττ final states at the CMS experiment — •Moritz Molch[1], Ulrich Husemann[2], Nikita Shadskiy[1], Nicolò Trevisani[1], and Roger Wolf[1] — [1]Institute of Experimental Particle Physics (ETP), Karlsruhe Institute of Technology (KIT) — [2]Deutsches Elektronen-Synchrotron (DESY), Hamburg

Extensions of the Standard Model (SM), like the Next-to-Minimal Supersymmetric Standard Model (NMSSM), introduce additional Higgs bosons in addition to the SM Higgs boson H. This talk presents a search for the resonant decay of a heavier scalar particle X into a lighter resonance Y and H at the CMS experiment, using data from the LHC Run 3. The analysis considers final states, in which either the Y or the H boson decays into a pair of bottom quarks, and the other one into a pair of τ leptons. Backgrounds from jets which are misidentified as hadronic τ lepton decays (τ_{h}) pose a challenge in this search as they are difficult to model in simulation. Therefore, data-driven techniques are used to control these backgrounds. For signal extraction, a parametric deep neural network is used, which enables the treatment of all signal hypotheses with a single neural network at once. Expected upper limits on the signal cross sections times branching fractions are presented to quantify the sensitivity of this search in the parameter space spanned by the unknown masses of the X and Y bosons.

T 101.2 Fri 9:15 KH 02.018

Studies towards a search for heavy resonances X→YH→tt̄bb̄ in the single-lepton final state with CMS — •Syed Sajal Hasan, Matteo Bonanomi, Mathis Frahm, Johannes Haller, Lara Sophie Markus, and Matthias Schröder — Institut für Experimentalphysik, Universität Hamburg

Many theories of physics beyond the Standard Model (SM) predict additional heavy particles, such as new scalars in extended Higgs sectors. In this study, we explore a generic scenario in which a heavy resonance X decays into a lighter new particle Y and a SM-like Higgs boson (H), X→YH, followed by Y→tt̄ and H→bb̄ decays. This cascade topology has not yet been probed at the LHC. The analysis uses simulated CMS data at a centre-of-mass energy of 13.6 TeV and targets events with a single isolated lepton and multiple jets. Candidate events are selected based on jet and b-tagged-jet multiplicities, and a neural network classifier is employed to enhance the separation between signal and SM backgrounds. Expected exclusion limits are presented as a function of the masses of X and Y for the signal production cross-section.

T 101.3 Fri 9:30 KH 02.018

Probing Dark Matter via the mono-Higgs signature in the $\tau^+\tau^-$ final state with the ATLAS detector — •Athul Dev Sudhakar Ponnu and Stan Lai — II. Physikalisches Institut, Georg-August-Universität Göttingen

This analysis searches for physics beyond the Standard Model using the mono-Higgs signature, in which a Higgs boson decaying to a pair of tau leptons ($H \to \tau^+\tau^-$) recoils against significant missing transverse momentum ($E_{\mathrm{T}}^{\mathrm{miss}}$). This event topology provides a sensitive and direct probe of the dark-matter sector. The results can be interpreted within the framework of the Two Higgs Doublet Model extended by a pseudoscalar mediator (2HDM + a), considering both Type-I and Type-II Yukawa coupling scenarios.

The analysis focuses on the $\tau_{\mathrm{had}}\tau_{\mathrm{had}}$ and $\tau_{\mathrm{lep}}\tau_{\mathrm{had}}$ final states using $\sqrt{s} = 13.6$ TeV collision data. Monte Carlo samples of $t\bar{t}$, single-top, diboson, W/Z+jets, and Higgs processes are used to model the Standard Model backgrounds, while dedicated signal samples spanning multiple mass hypotheses are employed to assess sensitivity to new physics. The early stages of the study, including data-MC agreement checks and multivariate analysis training, are presented in this talk.

T 101.4 Fri 9:45 KH 02.018

Search for an Intermediate-Mass Higgs Boson in the $\tau + \tau$ Channel with Run 2 Data — •Luka Vomberg[1], Christian Grefe[2], Philip Bechtle[1], and Klaus Desch[1] — [1]Physikalisches Institut Bonn, Käthe-Kümmel-Str. — [2]1, Esplanade des Particules, Meyrin, Switzerland

A search for additional Higgs bosons decaying to $\tau + \tau$ in the intermediate mass range, as motivated by extended Higgs sector models such as the 2HDM, is presented. The analysis targets the $\tau_{had} + \tau_{had}$ and $\tau_{lep} + \tau_{had}$ final states and considers both ggF and VBF production modes. Limits are derived on the production cross-section times branching ratio, following a model-independent approach.

This is the first ATLAS analysis probing the 80 GeV to 200 GeV mass range in the $\tau\tau$ final state using full Run 2 data, complementing existing high-mass searches. This analysis is a re-interpretation of the standard model $H \to \tau\tau$ cross section measurement.

Preparations for a follow up analysis using run 3 data are ongoing, with the primary focus on improving suppression of the dominant $Z \to \tau\tau$ background using spin sensitive observables to increase sensitivity in the low-mass region, as well as including effects of interference near the Z-pole.

T 101.5 Fri 10:00 KH 02.018

Exploring boosted top quark decays using Run 3 data collected by the CMS experiment — •Johanna Matthiesen[1], Johannes Haller[1], Roman Kogler[2], and Daniel Savoiu[1] — [1]Institut für Experimentalphysik, Universität Hamburg — [2]DESY, Hamburg

Highly energetic top quarks produced in proton-proton collisions at the LHC can result in decay products that are highly collimated, appearing as a single large-radius jet in the CMS detector. These jets exhibit a distinctive internal substructure, enabling discrimination between top quark jets and those arising from other QCD processes. This boosted topology offers a unique opportunity to probe for new heavy particles decaying into top-antitop quark pairs. This presentation provides first insights from the ongoing data taking at the LHC, focusing on the top-antitop quark mass spectrum as a potential window to new physics phenomena with a focus on heavy Z' bosons. The analysis strategy as well as first results will be presented.

T 101.6 Fri 10:15 KH 02.018

Anomaly detection for multi-jet resonances. — •Chitrakshee Yede, Louis Moureaux, Gregor Kasieczka, and Tore von Schwartz — University of Hamburg, Hamburg, Germany

The search for physics beyond the standard model is one of the main focuses in high-energy physics. Conventional searches at the LHC, though comprehensive, have not yet shown signs for new physics. Machine learning based anomaly detection has emerged as a powerful tool to widen the discovery horizon, offering a model-agnostic path as a way to enhance the sensitivity of generic searches as compared to those targeting specific signal models. CATHODE (Classifying Anomalies THrough Outer Density Estimation), one of these methods, is a two-step method that combines a data driven background estimation with a classifier flagging potential signal. To date, most studies have mainly focused on dijet resonances. In this work, we explore signals with multiple decays modes, leading to a more challenging detection scenario. We present the first application of CATHODE to multi-jet resonances, which enhance the sensitivity beyond the dijet regime and increase the robustness of weakly supervised anomaly detection, thereby broadening its applicability.