T 58: Searches/BSM III

Time: Wednesday 16:15–18:00 Location: KH 02.018

T 58.1 Wed 16:15 KH 02.018

Search for new physics in the final state with a tau lepton and missing transverse momentum using Run-3 CMS data — Thomas Hebbeker, Kerstin Hoepfner, Mirac Noyan Özdemir, Valentina Sarkisovi, Alexander Schmidt, and •Joseph Karl Schumacher — III. Physikalisches Institut A, RWTH Aachen University

Various extensions to the Standard Model predict new particles, which can decay into final states characterized by high-energy lepton-neutrino pairs. The CMS detector at the CERN LHC is used to investigate deviations from predictions of the Standard Model in the high transverse mass region of the $\tau + p_T^{miss}$ spectrum. Efficient identification of TeV-scale τ leptons, precise modeling of the high transverse mass region and sensitivity to a wide range of models are essential in the search for Beyond the Standard Model (BSM) physics in this channel. CMS data recorded in Run-3 pp-collisions with a center-of-mass energy of 13.6 TeV have been analyzed to this end. This talk presents the key concepts of the analysis techniques used in the search for BSM physics in the $\tau + p_T^{miss}$ channel, including statistical interpretations in terms of various BSM models, with a special interest in models with preferred coupling to third generation leptons.

T 58.2 Wed 16:30 KH 02.018

Search for New Physics in Events with an Energetic Jet and Missing Transverse Momentum with the ATLAS Experiment — •Moritz Hesping, Volker Büscher, Christian Schmitt, and Duc Bao Ta — Johannes Gutenberg Universität Mainz

A wide range of theories beyond the Standard Model predict particles which only weakly interact with SM particles. If such particles are produced in collisions at the Large Hadron Collider, they are invisible to the detector. However, their presence can be inferred from a large missing transverse momentum when they recoil off a highly energetic jet. This requires a precise estimation of the SM processes resulting in a similar signature, such as the production of Z bosons decaying to neutrinos.

Searches for new physics in such events have been previously carried out at the ATLAS experiment using the full 140 fb^{-1} dataset of the LHC Run 2 (2015-2018). This talk shows the progress of an updated analysis using data from the ongoing LHC Run 3, which at 160 fb^{-1} for the years 2022-2024 has already exceeded Run 2 in luminosity, including an overview of the analysis strategy and data-simulation comparisons in the control regions, as well as systematic uncertainties.

T 58.3 Wed 16:45 KH 02.018

Search for new physics in the electron plus missing transverse momentum channel using Run-3 CMS data — Thomas Hebbeker, Kerstin Hoepfner, •Mirac Noyan Özdemir, Valentina Sarkisovi, Alexander Schmidt, and Karl Joseph Schumacher — III. Physikalisches Institut A, RWTH Aachen University

There are many Beyond the Standard Model (BSM) theories that predict new particles in the final state with a high-energy lepton and missing transverse momentum as their experimental signature. Now, using the newly acquired data of the CMS detector from the ongoing Run-3 at an unprecedented center-of-mass energy of 13.6 TeV, a new window is opened for searches in the high-energy regions.

This talk presents the main ideas behind the search for high-mass resonances and the analysis strategy in the electron plus missing transverse momentum channel. Among other results, the comparison of the observed data to the expected background, including a data-driven background estimation method, and several theoretical interpretations, will be shown.

T 58.4 Wed 17:00 KH 02.018

Search for Asymmetric Leptoquark Production in the Multilepton Channel with ATLAS Data — Ondrej Matousek, André Sopczak, and •Ishaan Utkarsh — CTU in Prague

The latest results in the search for asymmetric leptoquark production in the multilepton channel are presented using ATLAS data.

T 58.5 Wed 17:15 KH 02.018

Improved strategy for searches for Heavy Neutral Leptons decaying into $\ell + \pi$ with ATLAS — •Andrej Prescher — Humboldt Universität zu Berlin

Heavy Neutral Leptons (HNLs) appear in beyond Standard Model scenarios and can address open problems such as neutrino masses and the matter-antimatter asymmetry. At the LHC, long-lived HNLs might be produced in leptonic W decays, $W \to \ell N$ ($\ell = e, \mu$), and lead to displaced decay signatures inside the detector.

The most stringent limits set in ATLAS searches so far have been achieved in the purely leptonic decay channels $N \to \ell\ell'\nu$. For small HNL masses, in the mass range of 2-3 GeV the two body decay $N \to \ell + \pi$ might help to increase the search sensitivity.

In a recently published ATLAS analysis this decay channel however could not significantly improve the sensitivity beyond the one from $N \to \ell\ell'\nu$, due to higher background level in the $N \to \ell + \pi$ search.

In this presentation we show studies how this background can be significantly reduced while keeping or even increasing the signal efficiency.

T 58.6 Wed 17:30 KH 02.018

Exploring OmniJet-α for Model-Agnostic Anomaly Detection with CATHODE — •Salome Fresenbet[1], Gregor Kasieczka[1], Louis Moureaux[1], Anna Hallin[1], Joschka Birk[1], Humberto Reyes Gonzalez[2], and Soumya Shaw[3] — [1]University of Hamburg — [2]RWTH Aachen University — [3]Saarland University

Model-agnostic anomaly detection has become an important complement to traditional, signal-driven searches for new physics at the LHC. One such method is CATHODE, which combines conditional density estimation in invariant-mass sidebands with a weakly supervised classifier in the signal region. In this talk, we present the integration of the jet foundation model OmniJet-α into CATHODE by training it to distinguish signal events from background events modeled by the generative component of CATHODE. We evaluate this approach on a dijet dataset with beyond-the-Standard-Model (BSM) benchmark resonance signals, which we use as a realistic anomaly-detection scenario. The aim of this ongoing study is to quantify the impact of jet foundation models on CATHODE's performance and how they may enhance the sensitivity of future model-agnostic searches.

T 58.7 Wed 17:45 KH 02.018

Significance metrics for anomaly detection with the CATHODE method — •Tore von Schwartz, Louis Moureaux, Gregor Kasieczka, Chitrakshee Yede, and Kristian Warnholz — University of Hamburg, Hamburg, Germany

Despite an extensive search program at the LHC, no evidence for new physics has been found so far. Anomaly detection has emerged as a promising approach bridging generic searches and analyses targeting specific signals. CATHODE, a model-agnostic anomaly detection method, is designed to enhance resonant signals in the smoothly falling dijet invariant mass spectrum. We present an investigation of different strategies for extracting the signal significance after applying this method, with the aim of improving sensitivity to potential new physics signals while maintaining calibration.