T 106: Searches IV

Time: Thursday 15:50–17:05 Location: HSZ/0403

T 106.1 Thu 15:50 HSZ/0403

Using Density Estimation for Resonance Searches at the LHC — Thorben Finke, •Marie Hein, Michael Krämer, and Alexander Mück — Institute for Theoretical Particle Physics and Cosmology (TTK), RWTH Aachen University, Germany

We demonstrate an end-to-end application of model-agnostic weakly supervised machine learning methods improving a traditional resonant anomaly search. In particular we focus on the Cathode method and show its superior performance and its limitation at the example of the LHC Olympics R&D data set. For our specific search strategy, we discuss the treatment of systematic errors, however, the potential issue of background sculpting is absent. The method is powerful at present and will benefit substantially from increased statistics to be collected at the LHC.

T 106.2 Thu 16:05 HSZ/0403

Searches for new physics with MUSiC in pp collisions at $\sqrt{s}$ = 13 TeV — •Yannik Kaiser, Thomas Hebbeker, Arnd Meyer, Ana Rita Alves Andrade, and Felipe Torres da Silva de Araujo — III. Physikalisches Institut A, RWTH Aachen University

Besides the large effort of the LHC collaborations, no direct evidence for physics beyond the standard model (BSM) has been found. Considering several theory models available, which adress the inadequacies of the standard model (SM), many model-specific searches have been employed. Complementary to this approach is MUSiC - Model Unspecific Search in CMS - a model-independent search procedure in which data collected by the CMS experiment, with at least one identified lepton, is classified according to its final state multiplicities of well-reconstructed objects. For each class a search algorithm is used to determine the most stringent phase-space region, according to a defined p-value, with respect to an SM statistical model. The procedure also takes into account systematic and statistical effects. As an extension of the already published result using 2016 data, we report preliminary results of the MUSiC search on data collected by CMS during 2018, corresponding to 58.83 fb^{-1} of integrated luminosity.

T 106.3 Thu 16:20 HSZ/0403

Search for new physics in the final state with a lepton and $\overrightarrow{p}_{\mathrm{T}}^{\mathrm{miss}}$ — •Valentina Sarkisovi, Thomas Hebbeker, Kerstin Hoepfner, Sebastian Wiedenbeck, and Christoph Schuler — III. Physikalisches Institut A, RWTH Aachen University

Various Beyond the Standard Model (BSM) theories anticipate the existence of new particles that could decay into final states characterized by the presence of a charged lepton and missing transverse momentum ($\overrightarrow{p}_{\mathrm{T}}^{\mathrm{miss}}$) as their most distinctive experimental signature. The CMS detector at the CERN LHC is used to hunt for novel physics in the high mass region of final states containing a lepton (electron, muon, tau) and $\overrightarrow{p}_{\mathrm{T}}^{\mathrm{miss}}$. Achievement of a high mass resolution, rejection of the standard model backgrounds, and efficient identification and reconstruction of TeV leptons are crucial in a search for such phenomena. One of the main challenges of this search is represented by the high rate of QCD multi-jet background produced in the LHC proton-proton collisions, leading to the possible misidentification of a jet as a lepton. Data driven methods as well as advanced machine learning technologies are used to model the QCD contamination and to properly identify leptons. The latest CMS data, recorded in 2022 at unprecedented center-of-mass energy of 13.6 TeV, have been analysed. The key concepts of the analysis techniques employed in the search for new physics in the final state with a lepton and $\overrightarrow{p}_{\mathrm{T}}^{\mathrm{miss}}$ are addressed.

T 106.4 Thu 16:35 HSZ/0403

Leptoquark production in a single τ charm/bottom and met final state at the ATLAS detector — •Patrick Bauer, Philip Bechtle, and Klaus Desch for the ATLAS-Collaboration — Physikalisches Institut Bonn

At B-factories, anomalies were observed in decays of the B-hadrons into $D^{(*)}$ and $K^{(*)}$ plus leptons, which are consistent with the hypothesis of contributions from Leptoquarks in the high GeV to low TeV range.

Therefore, the direct search for leptoquarks (LQ) is a focus at high energy collider experiments. A very recent result, where CMS observes an excess of 3.4 sigma consistent with non-resonant LQ contributions, potentially provides an even stronger case.

This observation emphasizes the importance of exploiting all possible LQ production modes. For for LQ masses well above 1 TeV the single- and non-resonant production modes become an key ingredient for ongoing an future searches. With the single production into final states with one τ, bottom or charm jet with large missing transverse momentum, one can directly probe the couplings expected to be involved in the $B \to D^{(*)}\tau\nu$ anomaly. Furthermore the non resonant contributions to the same final state could give sizable sensitivity to higher masses for large coupling strengths from the LQ. For the inclusion of a non-resonant interpretation it is crucial to study the interference behaviour of LQ signal with the SM.

This talk will provide an overview over the ongoing search for singly produced LQ in the given final states, covering resonant, non-resonant and interference aspects.

T 106.5 Thu 16:50 HSZ/0403

Search for Beyond Standard Model particles with exclusive coupling to top quarks in four-top-quark final states — •Gabriele Milella[1], Freya Blekman[1], Matthias Komm[1], and Denise Müller[2] — [1]DESY, Hamburg, Germany — [2]VUB, Brussel, Belgium

Many Beyond Standard Model (BSM) theories predict new top-philic particles that couple exclusively with the top quark, as this coupling is the most favorable for new physics with respect to any other lighter quark.
This search is therefore focused on a heavy resonance decaying to a pair of top quarks. The resonance is produced in association with a top quark pair resulting in four top quarks in the final state.
The two top quarks from the resonance are expected to be highly boosted and their decay products can be found within large-radius jets. The signal region is constructed from events that contain also opposite-sign leptons and b-tagged jets.
The invariant mass distribution of the reconstructed pair of large-radius jets is studied. Various signal scenarios with different resonance masses and decay widths are tested by searching for local excesses in the reconstructed mass spectrum of the large-radius jets. Preliminary results are presented using the LHC Run 2 data taken with the CMS experiment.