T 37: Search for New Particles II

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

T 37.1 Tue 16:00 Tl

Model Unspecific Search in CMS (MUSiC) - Overview — •Saranya Samik Ghosh, Thomas Hebbeker, Arnd Meyer, and Lorenzo Vigilante — III. Physikalisches Institut A, RWTH Aachen, 52074 Aachen, Germany

The Model Unspecific Search in CMS (MUSiC) is a long-term project aiming to search for new physics beyond the standard model (BSM) by searching for significant deviations from the standard model (SM) expectation in LHC data. Kinematic distributions of the data are compared with the SM expectation in hundreds of different final states using an automated procedure with a minimum of additional assumptions, and in particular without optimization for specific models beyond the SM. In this presentation, the general method and its current implementation will be discussed, pointing out limitations and applications beyond the original scope, as well as methods used for validation and benchmarking.

T 37.2 Tue 16:15 Tl

Model Unspecific Search in CMS (MUSiC) - Results — •Lorenzo Vigilante, Arnd Meyer, Saranya Samik Ghosh, and Thomas Hebbeker — III. Physikalisches Institut A, RWTH Aachen, 52074 Aachen, Germany

The CMS experiment has been collecting data during proton-proton collisions at a center of mass energy of 13 TeV during Run 2 of the CERN LHC. This presents a unique opportunity to search for new physics phenomena beyond the Standard Model. The majority of searches for new physics are optimized for an established signal hypothesis in one or few decay channels. These searches cover only a fraction of all observed final states with model dependent analysis strategies. The Model Unspecific Search in CMS (MUSiC) provides a unique procedure to search for new physics at CMS in several hundred final states that are not all covered by dedicated analyses. This talk extends the previous introductory talk and presents the results of the MUSiC analysis using 35.9 fb^{-1} of data recorded by the CMS detector at the LHC during proton-proton collisions at a center of mass energy of 13 TeV. The overall agreement between the CMS data and simulation of the Standard Model is evaluated and most significant deviations are studied.

T 37.3 Tue 16:30 Tl

Resonant Single BSM Particle Production at the LHC using Lepton PDFs — •Jonas Botz, Saurabh Nangia, Yong Sheng Koay, Philip Bechtle, Klaus Desch, Herbert Dreiner, and Manuel Drees — Physikalisches Institut der Rheinischen-Friedrich-Wilhelms-Universität Bonn

Many new physics scenarios require particles (leptoquarks) that couple to a vertex at which both leptons and quarks interact. Indeed, leptoquark searches have received considerable interest at the LHC. Recently, however, a new search strategy has been proposed. Combining QCD and QED effects, there is a non-zero probability to find leptons with a certain momentum inside the proton, described by the lepton parton distribution functions (PDFs). Such PDFs have recently been calculated for the first time. This allows us to study resonant leptoquark production at the LHC. In the following phenomenological study, a search strategy is analysed for resonant leptoquark production at the LHC using the one lepton and one jet final state. After identifying the most relevant backgrounds and discussing cuts, parameter space diagrams of minimal leptoquark models are shown to demonstrate the LHC sensitivity.

T 37.4 Tue 16:45 Tl

Machine Learning Based Dijet Anomaly Search — Lukas Judith, Gregor Kasieczka, •Tobias Lösche, and Manuel Sommerhalder — Institut für Experimentalphysik, Luruper Chaussee 149, 22761 Hamburg

The search for particles and phenomena beyond the Standard Model (BSM) is a crucial part of the current LHC physics program. Although considerable effort has been put into the investigation of BSM physics at the LHC as well as other experiments, no evidence has been found so far. A major disadvantage of many current searches is their reliance on specific signal and background models. Since it is not feasible to cover all possible BSM models with a dedicated search and the unexplored regions of the LHC phase space are vast, it is necessary to develop novel model-independent anomaly detection methods, which can be directly trained on and applied to data.

One proposed method for model-independent anomaly detection is ANODE. It uses density estimation based on normalizing flows to learn the densities in signal and background regions and has achieved state-of-the-art results in a recent community study. We present the first application of ANODE for a search for new physics with the CMS experiment in the dijet final state.

T 37.5 Tue 17:00 Tl

Search for new particles in events with four top quarks at the ATLAS detector — •Alicia Wongel[1], Krisztian Peters[1], Philipp Gadow[1], Xingguo Li[1], Christopher Pollard[1], James Ferrando[1], Loic Valery[1], Nedaa-Alexandra Asbah[2], Elise Le Boulicaut[3], Mark Kruse[3], Ashutosh Kotwal[3], Katherine Pachal[3], Sourav Sen[3], Samuel Calvet[4], William Barbe[4], Qin Yang[5], and Masahiro Morii[2] — [1]DESY Hamburg — [2]Harvard University — [3]Duke University, Department of Physics — [4]Laboratoire de Physique de Clermont-Ferrand (LPC), Universite Clermont Auvergne — [5]University of Manchester

A novel search for anomalous production of four-top-quark events is presented. It offers a unique way to probe top-philic resonances (Z') which can only be produced in association with top quarks ($t\bar{t}Z' \to t\bar{t}t\bar{t}$) and thus are inaccessible by conventional searches. The Run 2 LHC proton-proton collision data recorded with the ATLAS detector is used in the search to select events with exactly one reconstructed lepton. This selection ensures high signal acceptance while suppressing multijet process events. Furthermore, the particular configuration where the resonance decays fully hadronically is investigated. A potential signal would manifest itself as a localized excess over the steeply falling mass spectrum of the two top quarks with the highest momentum which are reconstructed in their hadronic decay mode ($m_{t\bar{t}}$). In this talk, an overview of the analysis strategy is given, highlighting the data-driven background estimation.

T 37.6 Tue 17:15 Tl

Searching for high-mass resonances decaying to $\tau\nu$ in pp-colisions at $\sqrt{s} = 13$ TeV with the Run-2 data of the ATLAS detector — •Christos Vergis and Jochen Dingfelder — University of Bonn, Bonn, Germany

Several theories Beyond the Standard Model predict the presence of new heavy charged gauge bosons (W') that could be produced at the LHC. The leptonic decays of the W' result in a high-p_{T} lepton and large missing momentum from the undetected neutrino. Although for models with universal lepton couplings the searches for $W' \to (e/\mu)\nu$ are more sensitive than $W' \to \tau\nu$, the latter is motivated by models that predict preferential W' couplings to the third generation of fermions.

This talk will present the latest results from the search for heavy resonances decaying to a tau lepton and a neutrino, in events where the tau lepton decays hadronically, using data collected during 2015-2018 pp-collisions at $\sqrt{s} = 13$ TeV by the ATLAS detector at the LHC. Recent updates to the background estimation and analysis strategy will be discussed. Exclusion limits on the W' masses in the Sequential Standard Model and models with preferential couplings to the third generation of fermions will be given. Finally, model-independent upper limits on the production cross-section times branching ratio for mono-tau signatures at ATLAS will be shown.

Following the increase in luminosity as well as upgrades in the tau reconstruction algorithms and analysis strategy, the reach of the search is significantly improved compared to the 36.1 fb^{-1} ATLAS results.

T 37.7 Tue 17:30 Tl

Search for heavy resonances decaying to ZH in the H→WW→4q/H→cc channel at CMS — •Andrea Malara, Paolo Gunnellini, Johannes Haller, Roman Kogler, and Matthias Schröder — Institut für Experimentalphysik, Universität Hamburg, Hamburg, Germany

A search for new heavy particles decaying to a Higgs boson and a Z boson is presented. The analysis is performed on the dataset recorded by the CMS experiment in proton−proton collisions at a centre-of-

mass energy of 13 TeV during Run-2, corresponding to an integrated luminosity of 137.2 fb^{-1}. The focus is set on the H→WW→4q/H→cc final states. Expected exclusion limits on the production cross section are reported using a combination of the leptonic Z decay modes.

T 37.8 Tue 17:45 Tl

Search for singly produced excited bottom quarks decaying to tW with the CMS experiment — •Alexander Fröhlich, Johannes Haller, Roman Kogler, and Matthias Schröder — Institut für Experimentalphysik, Universität Hamburg

We present a search for a singly produced excited bottom quark (b*) in data of pp-collisions at $\sqrt{s} = 13\,\text{TeV}$ recorded with the CMS detector. The search is performed in the tW decay channel, where the top quark decays hadronically, while the W boson decays into a lepton and a neutrino.

The reconstruction and identification of the top quark is done with the Heavy Object Tagger with Variable R (HOTVR). The stable performance of this algorithm allows for a high signal sensitivity over a wide range of b* masses. Data driven methods are used to estimate standard model background contributions from misidentified objects.

T 37.9 Tue 18:00 Tl

Lowering the dijet resonance mass threshold for a trigger-level analysis in ATLAS — Falk Bartels and •Hagen Tockhorn — Kirchhoff-Institut für Physik, Heidelberg, Deutschland

The search for sub-TeV dijet resonances at the LHC is statistically limited due to the reduced readout rate of lower p_T jet triggers. The ATLAS trigger-level analysis covers this part of the spectrum by recording a strongly reduced set of event-level information processed by the High Level Trigger for all events passing the seeding Level-1 trigger. This has so far allowed for lowering the minimal detectable dijet resonance mass from ≈1 TeV to 450 GeV.

To further lower this threshold, a novel approach for defining the signal region is presented. Selecting the efficient phase space of the jet trigger based on the dijet mass instead of the leading jet p_T can yield significantly lower mass thresholds. Additionally, the potential of including even lower p_T Level-1 triggers is investigated.