T 61: Search for New Particles III

Time: Wednesday 16:00–18:15 Location: Tk

T 61.1 Wed 16:00 Tk

Search for heavy resonances decaying into ZH with Z→νν and H→WW→4q at CMS — •Tom Sokolinski, Johannes Haller, Roman Kogler, Andrea Malara, and Matthias Schröder — Institut für Experimentalphysik, Universität Hamburg

A search for new heavy particles decaying into a Higgs 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 in the years 2016-2018, corresponding to an integrated luminosity of 137.2 fb^{-1}.

The final state resulting from Z→νν and H→WW→4q decays is analysed. Expected upper exclusion limits on the production cross section of the new resonance are derived.

T 61.2 Wed 16:15 Tk

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 61.3 Wed 16:30 Tk

A multi-dimensional search for new heavy resonances decaying to boosted WW, WZ, ZZ, WH or ZH boson pairs in the all jets final state at 13 TeV — •Irene Zoi[1], Anna Benecke[1], Andreas Hinzmann[1], Robin Aggleton[1], and Daniela Schaefer[2] — [1]Institut für Experimentalphysik, Universität Hamburg, Luruper Chaussee 149, 22761 Hamburg, Deutschland — [2]KIT

The standard model (SM), 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 SM predict the existence of new massive resonances. Here a search for such 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 in this search. 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, the decay products of each boson are expected to be collimated into one single jet, substructure techniques are exploited to significantly reduce the SM background. Improvements in boson tagging techniques and sensitivity estimates will be presented.

T 61.4 Wed 16:45 Tk

A search for pair production of excited top quarks t^* at CMS — •Finn Labe, Paolo Gunnellini, Johannes Haller, Anastasia Karavdina, Roman Kogler, Andrea Malara, and Matthias Schröder — Institut für Experimentalphysik, Universität Hamburg

A search for pair production of excited top quarks t^* in the decay channel $t^*t^* \to tgtg$ is presented. The search is performed in the boosted lepton + jets final state using data collected from proton-proton collisions at a center-of-mass energy of 13 TeV during Run-2 of the CMS experiment, corresponding to 137 fb^{-1} of data. After a preselection, a deep neural network is used for discrimination of signal from background. The network inputs have been decorrelated from the sum of all jet momenta H_T, which is used to set expected exclusion limits. This approach is compared to the usage of the reconstructed t^* mass and yields promising results over the full mass range analyzed.

T 61.5 Wed 17:00 Tk

Observation of an excess at 30 GeV in the opposite sign di-muon spectra of $Z \to b\bar{b} + X$ events recorded by the ALEPH experiment at LEP — •Arno Heister — Hergenrath, Belgium

The re-analysis of the archived data recorded at the Z^0 resonance by the ALEPH experiment at LEP during the years 1992-1995 shows an excess in the opposite sign di-muon mass spectra at 30.40 ± 0.46 GeV in events containing b quarks. The excess has a natural width of 1.78 ± 1.14 GeV. The di-muon excess has a local significance around 5 σ (Z_{asym}), depending on the background model used. The significances for background models based on a kernel density approximation stay close to 3 σ ($Z_{\mathrm{freq,\ lee}}$), when including a look elsewhere effect. Another method to obtain a significance value results in at least 2.6 σ (Z_{Bi}). A compatible, but smaller excess is visible in the opposite di-electron mass spectrum as well. Several experiments have data samples that include the di-lepton mass region discussed here. The excess described in the paper arXiv:1610.06536 may be present in data of other experiments at LEP, the Tevatron and the LHC. Former members of the L3 collaboration as well as the ATLAS and CMS collaborations have published the result of their searches for this excess. The L3 data and the CMS data shows a noteworthy excess. The ATLAS experiment did not find anything in its data, yet.

T 61.6 Wed 17:15 Tk

Search for resonant WZ production with the ATLAS detector at the LHC — •Abhishek Nag, Joany Manjarres, and Michael Kobel — Institut für Kern und Teilchenphysik, Technische Universität Dresden

In the Standard Model (SM) the low mass of the Higgs boson leads to hierarchy and naturalness problems and therefore there is a need for physics beyond SM. Heavy resonance decays provide simple ways to discover new physics and particles. The search for a resonance decaying into dibosons, such as WZ, is a model-independent powerful probe for physics beyond the SM.

In this talk I will present the details of the search for resonant WZ production decaying into fully leptonic final state with the ATLAS detector at the LHC with the full Run-2 dataset. The focus of the talk will be on the improvements and optimization of the analysis selection. Parametrization of Heavy Vector Triplet Lagrangians and the Georgi-Machacek Model are used to optimize and interpret the search results.

T 61.7 Wed 17:30 Tk

Search for new physics in the τ+MET final state with CMS — •Christoph Schuler, Kerstin Hoepfner, Thomas Hebbeker, and Swagata Mukherjee — III. Physikalisches Institut A, RWTH Aachen University

A search for new physics in the τ + missing transverse energy (MET) channel is presented based on proton-proton collisions measured with the CMS detector at the LHC, using the full Run-II CMS data set recorded at a center of mass energy of 13 TeV. The analysis strategy is discussed and the results are interpreted in the context of various models predicting enhancements to the Standard Model in the high mass region.

T 61.8 Wed 17:45 Tk

Search for long-lived particles decays in the CMS muon system — •Jörg Schindler[1], Lisa Benato[1], Gregor Kasieczka[1], Cristián Peña[2], Christina Wang[3], and Si Xie[3] — [1]Universität Hamburg, Germany — [2]Fermilab, USA — [3]Caltech, USA

Traditionally, searches for new physics at the LHC focused on already established objects, like photons, leptons, jets or missing energy. A different approach is to look for signatures in the detector which up until now were not considered. One example are long-lived particles, which can have a large lifetime leading to macroscopic flight distances ranging from a few micrometers up to several kilometers. Such particles are for example predicted by twin Higgs models, where a dark sector mirroring the Standard Model (SM) particles is introduced. The

Higgs boson mixes with its dark partner, acting as a mediator between the SM and dark sector and therefore can decay into non-SM particles. These non-SM particles are the long-lived neutral scalars π_ν, which later decay back into SM particles - in this case assumed to be predominantly b quarks.

In this talk a search for long-lived particles decaying in the CMS muon system is presented. These signatures can be observed with close to no background, but require the development of new reconstruction and analysis tools.

The status of the current search for LLPs with decays in the muon system is shown, using data collected by the CMS detector in run 2.

T 61.9 Wed 18:00 Tk

Searches for long-lived particles produced in Higgs decays with b-quark like signature — •Melanie Eich, Lisa Benato, Gregor Kasieczka, Karla Pena, and Joerg Schindler — Institut für Experimentalphysik, Universität Hamburg

Beyond Standard Model (BSM) theories including neutral, long-lived particles (LLP) can solve the hierarchy problem. In these theories, a mirror version of SM gauge groups exists alongside additional fermions. SM and mirror particles are connected via a discrete symmetry. In our analysis the Higgs boson is assumed to be the mediator between the two groups, because it mixes with its mirror partner. We further assume Higgs boson decays into a pair of long-lived neutral scalars π_ν.

We show results for the case that each π_ν decays into two b-quarks, with π_ν lifetimes measured as $c \cdot \tau$ in the order of up to a few millimetres. Such a lifetime results in a displaced vertex (DV), mimicking a b-quark like signature. The search for such π_ν requires new analysis techniques to distinguish between decay products coming from DV and background events. We present a comparison of different reconstruction techniques including machine learning methods and show the achievable sensitivity to twin Higgs production as a function of the mass and lifetime of the π_ν. In this talk an overview of the analysis and its current status and results will be presented, using data recorded with the CMS detector in Run2.