T 81: Search for new particles 5 (SUSY)

Time: Thursday 16:00–17:45 Location: Geb. 20.30: 1.067

T 81.1 Thu 16:00 Geb. 20.30: 1.067

Search for Dark Matter in association with a hadronically decaying top quark at the CMS experiment — •Michael Wassmer, Ulrich Husemann, Moritz Molch, and Sebastian Wieland — Institute of Experimental Particle Physics (ETP), Karlsruhe Institute of Technology (KIT)

In this talk a search for the production of Dark Matter in association with a single highly-energetic top quark is presented. In the standard model of particle physics such a final state can only be generated by higher-order effects and is, in addition, CKM and GIM suppressed, making it a prime candidate to search for new physics. The search is based on the total Run-2 dataset collected by the CMS collaboration. The mono-top signature is characterized by large missing transverse momentum and the well-known top quark decay. This talk is focused on the hadronic decay of the top quark. Large-radius jets are used to reconstruct the decay products and multivariate methods are employed to distinguish these jets from purely QCD-initiated jets. The results of the search are interpreted in the context of a simplified model introducing a flavor-changing neutral current at tree level by a spin-1 mediator and a Dirac Dark Matter particle.

T 81.2 Thu 16:15 Geb. 20.30: 1.067

Searches for new physics with MUSiC in pp collisions at $\sqrt{s} = 13$ TeV in 2018 CMS Data — Thomas Hebbeker, •Yannik Kaiser, Lucas Karwatzki, Arnd Meyer, Chinmay Seth, and Felipe Torres da Silva de Araujo — III. Physikalisches Institut A, RWTH Aachen University

Despite the large effort of the LHC collaborations, no direct evidence for physics beyond the Standard Model has been found. Considering several theory models available, which address the inadequacies of the Standard Model, 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 are classified according to their final state multiplicities of well-reconstructed objects. For each class a search algorithm is applied to identify regions where the CMS measurements deviate from the theoretical prediction. The algorithm is based on a well-defined p-value and a complete simulation of the Standard 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 81.3 Thu 16:30 Geb. 20.30: 1.067

Combination and Reinterpretation of LHC SUSY Searches — •Alexander Feike[1], Juri Fiaschi[2,3], Benjamin Fuks[4], Michael Klasen[1], and Alexander Neuwirth[1] — [1]Institut für Theoretische Physik, Universität Münster, Wilhelm-Klemm-Straße 9, 48149 Münster, Germany — [2]Department of Mathematical Sciences, University of Liverpool, Liverpool L69 3BX, United Kingdom — [3]Dipartimento di Fisica, Università degli Studi di Milano-Bicocca, Piazza della Scienza 3, I-20126 Milano, Italy — [4]Laboratoire de Physique Theorique et Hautes Energies (LPTHE), UMR 7589, Sorbonne Universite et CNRS, 4 place Jussieu, 75252 Paris Cedex 05, France

To maximise the information obtained from various BSM searches conducted at the LHC, it is imperative to contemplate the combination of multiple analyses. We consider a simplified SUSY scenario with all particles but one squark flavor and a bino like neutralino decoupled to showcase the exclusion power gained by combining uncorrelated signal regions of different analyses. This study includes the purely strong squark pair, the associated squark neutralino and the purely weak neutralino pair production, individually and their combination. We find that considering associated and strong production together significantly impacts the mass limit, while the contribution from the weak production is insignificant. In addition, we demonstrate that the combination of uncorrelated signal regions substantially pushes the exclusion limit towards higher masses, compared to the most sensitive individual analysis.

T 81.4 Thu 16:45 Geb. 20.30: 1.067

Automatic combinations of signal regions for pMSSM scans at the ATLAS detector — •Leon Renn, Jonas Würzinger, and Lukas Heinrich — Technical University Munich Data Science in Physics, Munich, Germany

The Large Hadron Collider (LHC) at CERN discovered the Higgs particle, concluding the search for elementary particles in the Standard Model (SM). However, the Higgs particle's mass challenges SM principles, suggesting physics beyond the SM (BSM). Supersymmetry (SUSY) elegantly addresses this issue by introducing supersymmetric partners. Despite extensive LHC analyses, no SUSY particles have been found. My thesis presents an automated method to combine numerous analyses, enhancing sensitivity to the phenomenological Minimal Super Symmetric Model (pMSSM). By identifying statistically uncorrelated analyses using an overlap matrix and a longest path algorithm, we efficiently determine the most sensitive combination. This novel approach significantly improves SUSY particle mass exclusion limits compared to individual analyses, with integration into the ATLAS collaboration's standard software.

T 81.5 Thu 17:00 Geb. 20.30: 1.067

Search for Dark Matter Using Two Soft Opposite-Sign Displaced Muons at the CMS Experiment — •Alexandra Tews — Universität Hamburg, Hamburg, Deutschland

A search for the decay of heavy neutral particles into a dark matter candidate and a pair of displaced, low-energetic muons is presented. The search targets supersymmetric extensions of the Standard Model of particle physics predicting light electroweakinos with compressed mass spectra in the selected parameter space with electroweakino mass differences ranging from 0.3 to 3.0 GeV. A bino or higgsino-like lightest supersymmetric particle (LSP) is considered, offering a dark matter candidate. The heavier neutralino ($\tilde{\chi}_2^0$) has a decay length of up to a few centimeters and the decay can lead to a pair of opposite-sign muons. The analysis concentrates on identifying displaced tracks of muon pairs, employing a specialized reconstruction and identification method for the displaced secondary decay vertex of the $\tilde{\chi}_2^0$. The background is estimated from a control region in the data.

Data corresponding to an integrated luminosity of 36.4 fb^{-1} collected by the CMS experiment in proton-proton collisions at $\sqrt{s} = 13$ TeV are analyzed.

T 81.6 Thu 17:15 Geb. 20.30: 1.067

Search for compressed electroweakinos in events with a low-momentum, displaced track at the CMS experiment — Samuel Bein, Peter Schleper, Alexandra Tews, and •Moritz Wolf — Universität Hamburg

Many supersymmetric extensions to the Standard Model predict the three lightest electroweakinos, χ_2^0, $\chi_1^\pm$, and χ_1^0, to be Higgsino-like with nearly degenerate masses around the electroweak scale. The lightest chargino and the second-lightest neutralino can be produced alongside another electroweakino and then decay to the lightest neutralino. To search for these particles, the best strategy depends on the differences between the various masses. For $\Delta m(\chi_2^0, \chi_1^0) > \mathcal{O}(1\,\text{GeV})$ lepton pairs from the decay of the second-lightest neutralino leave an experimentally distinct signature, whereas $\Delta m(\chi_1^\pm, \chi_1^0) \lesssim 0.3\,\text{GeV}$ can lead to the chargino giving rise to a disappearing track. However, for mass splittings in the range of $\Delta m(\chi_1^\pm, \chi_1^0) = 0.3 - 1.0\,\text{GeV}$, searches carried out so far at the LHC are lacking in sensitivity.

In this analysis, a slightly displaced track with small transverse momentum, corresponding to a pion originating from the chargino decay, is used to gain sensitivity to this challenging range of mass splittings.

T 81.7 Thu 17:30 Geb. 20.30: 1.067

Not so inelastic Dark Matter — •Giovani Dalla Valle Garcia[1], Felix Kahlhoefer[2], Thomas Schwetz[1], and Maksym Ovchynnikov[1,3] — [1]Institut für Astroteilchen Physik, Karlsruher Institut für Technologie (KIT), Hermann-von-Helmholtz-Platz 1, 76344 Eggenstein-Leopoldshafen, Germany — [2]Institute for Theoretical Particle Physics (TTP), Karlsruhe Institute of Technology (KIT), D-76131 Karlsruhe, Germany — [3]Instituut-Lorentz, Leiden University, Niels Bohrweg 2, 2333 CA Leiden, The Netherlands

Models of inelastic (or pseudo-Dirac) dark matter commonly assume an accidental symmetry between the left-handed and right-handed mass terms in order to suppress diagonal couplings. Here we point

out that this symmetry is unnecessary, because for Majorana fermions the diagonal couplings are in fact not strongly constrained. Removing the requirement of such an accidental symmetry in fact relaxes the relic density constraint, because additional annihilation modes can contribute, leading to larger viable parameter space. We discuss how the sensitivity of searches for both long-lived particles and missing energy signatures is modified in such a set-up, and explore the relevance of events with two long-lived particles.