

T 36: Search for Supersymmetry II

Time: Tuesday 16:00–17:45

Location: Tk

T 36.1 Tue 16:00 Tk

Search for disappearing tracks with the CMS experiment at $\sqrt{s} = 13$ TeV — ●VIKTOR KUTZNER¹, SAMUEL BEIN¹, SEH WOK LEE², SANG-IL PAK², PETER SCHLEPER¹, SEZEN SEKMEK², and ALEXANDRA TEWS¹ — ¹Institute for Experimental Physics, Hamburg University, Luruper Chaussee 149, D-22761 Hamburg, Germany — ²Kyungpook National University, Daegu, South Korea

Long-lived particles are often predicted in theories with a small mass splitting between the two lightest particles, for example a chargino and a neutralino in supersymmetry. Given a sufficiently small mass splitting in the range of $m_\pi \lesssim \Delta m \lesssim 200$ MeV, the chargino is expected to decay in the CMS tracker volume into soft non-reconstructed leptons or hadrons and a lightest supersymmetric particle, leaving a short track that then seems to disappear. This signature is characterized by missing hits in the outer layers of the tracker with little or no energy deposited in the calorimeter. In addition to events with one or more disappearing tracks, events with an additional lepton are considered as well to account for a second very long-lived chargino, which decays outside the tracker volume. For both topologies events with additional b-quark jets are investigated to account for gluino-/squark-associated chargino production. Data-driven methods are used to determine the dominant backgrounds arising from prompt leptons and fake tracks. Results are presented using proton-proton collision data with $\sqrt{s} = 13$ TeV collected with the CMS experiment during Run-2.

T 36.2 Tue 16:15 Tk

Search for compressed mass-spectrum long-lived particles using short disappearing tracks with the ATLAS experiment — ●PAUL GESSINGER and STEFAN TAPPROGGE — Johannes Gutenberg-Universität Mainz

In certain Supersymmetry scenarios, the lightest neutralino $\tilde{\chi}_1^0$ and charginos $\tilde{\chi}_1^\pm$ can become nearly degenerate in mass. At mass splittings as low as $\Delta m(\tilde{\chi}_1^\pm, \tilde{\chi}_1^0) \approx 100$ MeV, the chargino obtains lifetimes of $\mathcal{O}(1$ ns), which allows it to reach sensitive parts of the ATLAS experiment, before decaying, mostly to a neutralino leaving the detector without interacting, and a low momentum charged pion that is difficult to detect. This causes the chargino track to *disappear*.

The tracking systems and reconstruction algorithms of the ATLAS detector are designed to efficiently detect and reconstruct charged particles crossing all silicon sensor layers. Using specialized reconstruction techniques, it is possible to reconstruct short *tracklets*, which arise only from hits in the silicon Pixel detector. Previous ATLAS analyses used tracklets consisting of at least 4 Pixel hits and no hits in the silicon strip detector as disappearing track signatures to search for the aforementioned scenarios in LHC pp -collisions at 13 TeV.

This talk presents first results from the inclusion of short tracklets with only 3 hits. The analysis carried out in the context of a *pure-higgsino* signal scenario, featuring very short lifetimes. Background characteristics of this new tracklet type are evaluated, and signal efficiency is discussed. Expected sensitivity in the form of upper signal strength limits and mass exclusion limits is shown.

T 36.3 Tue 16:30 Tk

Search for Mono-Top Signatures in Compressed SUSY Scenarios in $\sqrt{s} = 13$ TeV pp collisions with the ATLAS Detector — ●PAOLA ARRUBARRENA and ALEXANDER MANN — Ludwig-Maximilians-Universität München

Supersymmetry (SUSY) is an extension of the Standard Model (SM) of particle physics which predicts a supersymmetric partner for each particle in the SM. A distinctive mono-top signature is present in Natural SUSY scenarios when the scalar top-quark (\tilde{t}) and higgsinos (\tilde{h}) are almost mass degenerate and their decay products are too soft to be detected. The mono-top signature is the SUSY counterpart of the $t\bar{t}H$ process, $pp \rightarrow t\bar{t}\tilde{h}$. This model can have a measurable production rate due to the large top Yukawa coupling, leading to a characteristic final state with a single top quark and missing transverse momentum. A strategy to discriminate the mono-top signal from the dominant backgrounds in the hadronic channel is presented.

T 36.4 Tue 16:45 Tk

Search for Higgsino production in SUSY scenarios with a compressed mass spectrum — ●YUVAL NISSAN¹, SAM BEIN¹, PE-

TER SCHLEPER¹, and GUDRID MOORTGAT-PICK² — ¹Institut für Experimentalphysik, Universität Hamburg — ²Institute of Theoretical Physics, DESY

A search for leptonic decays of Higgsino-like neutralinos in the case of a compressed mass spectrum using a track, a reconstructed lepton and missing transverse momentum is presented. We consider the case of a second-lightest neutralino decaying into a dark matter candidate - lightest neutralino - and two leptons via an off-shell Z boson. In the case of a very small mass differences between the neutralinos, the leptons produced are very soft, making it very difficult to reconstruct them at CMS. We consider a case where one of the leptons is reconstructed by a track, and the other as a reconstructed lepton of opposite charge. Signals of different mass splitting are probed and interpreted within a set of simplified models. Multivariate discriminants are employed in the event- and object-level selection, and their performance is studied.

T 36.5 Tue 17:00 Tk

Search for Compressed Higgsinos in events with two oppositely charged soft and displaced leptons at the CMS experiment — ●ALEXANDRA TEWS — Universität Hamburg, Hamburg, Deutschland

A variety of supersymmetric extensions of the Standard Model lead to light Higgsinos with compressed mass spectra and correspondingly large lifetime.

In case of pair production of Higgsino-like electroweakinos, e.g. χ_1^\pm, χ_2^0 , the decay of the second neutralino through an off-shell Z boson can lead to a pair of same-flavor opposite-sign leptons. These leptons can have very low momentum if the mass spectrum of the SUSY particles is sufficiently compressed (nearly degenerate).

Searches for SUSY in events with two low-momentum opposite-sign leptons are particularly sensitive to such SUSY models. Scenarios with compressed Higgsinos with a mass splitting below 2 GeV with the CMS experiment are studied. We exploit new reconstruction and vertexing techniques for oppositely charged displaced lepton tracks with very low momenta of order of a few hundred MeV.

T 36.6 Tue 17:15 Tk

Search for Higgsinos in final states with a low-momentum, displaced track at the CMS experiment — SAMUEL BEIN, VIKTOR KUTZNER, YUVAL NISSAN, PETER SCHLEPER, ALEXANDRA TEWS, and ●MORITZ WOLF — Universität Hamburg

Many supersymmetric extensions to the Standard Model predict the three lightest electroweakinos, $\chi_2^0, \chi_1^\pm, \chi_1^0$, to be Higgsino-like with similar masses around the electroweak scale. The lightest chargino and the second-lightest neutralino can be pair-produced and decay to the lightest neutralino. To search for these particles, the best strategy depends on the differences between their masses. For $\Delta m(\chi_2^0, \chi_1^0) > \mathcal{O}(1$ GeV) lepton pairs from the decay of the second-lightest neutralino leave an experimentally distinct signature, whereas $\Delta m(\chi_1^\pm, \chi_1^0) \lesssim 0.3$ GeV can lead to the chargino giving rise to a disappearing track. However, mass splittings in the range of $\Delta m(\chi_1^\pm, \chi_1^0) = 0.3 - 1.0$ GeV are still unexplored by either of those methods.

This study describes how a mono-jet analysis can be made more sensitive to Higgsinos with mass splittings in the latter range by requiring a slightly displaced track with low momentum in the event corresponding to a pion originating from the chargino decay.

T 36.7 Tue 17:30 Tk

Reinterpreting a search for electroweakinos in the phenomenological MSSM with the ATLAS detector. — ●ERIC SCHANET and JEANETTE LORENZ — Ludwig-Maximilians-Universität München

Supersymmetry is a popular extension of the Standard Model of Particle Physics (SM), providing a solution to several open questions of the SM. At the LHC, searches for supersymmetry (SUSY) are traditionally interpreted in simplified models containing a very limited number of free parameters. Although very useful for covering a wide range of phenomena, this method fails to capture more complex effects resulting from a larger set of parameters and the influence of different production and decay processes. Thus, it is of high interest to interpret

SUSY searches in more complete and realistic supersymmetric models.

In this talk efforts to reinterpret a search for electroweakinos in the phenomenological MSSM (pMSSM)—a 19-dimensional supersymmetric model space—are presented. In order to cope with the high dimensionality of the pMSSM, a method for computationally efficient but still reliable analysis approximations is introduced, and illustrated on

exemplary SUSY searches. Relying on full likelihoods of the respective searches, these approximations are not only crucial for reinterpretations in high-dimensional model spaces, but also serve as useful tools for theorists wishing to incorporate results from ATLAS SUSY searches in their work. Finally, results from a preliminary scan in the pMSSM are presented and discussed.