T 9: Search for Supersymmetry

Time: Monday 16:15–18:30 Location: T-H22

T 9.1 Mon 16:15 T-H22

Search for Higgsino production in SUSY scenarios with a compressed mass spectrum — •Yuval Nissan, Sam Bein, Peter Schleper, and Gudrid Moortgat-Pick — Universität Hamburg

A search for leptonic decays of Higgsino-like neutralinos in the case of a compressed mass spectrum using two soft lepton tracks 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 small mass differences between the neutralinos, the leptons produced are very soft, making them difficult to reconstruct at CMS. 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 9.2 Mon 16:30 T-H22

Search for Higgsinos in final states with a low-momentum, displaced track at the CMS experiment — Samuel Bein, Yuval Nissan, Peter Schleper, Alexandra Tews, and •Moritz Wolf — Universität Hamburg

Many supersymmetric extensions to the Standard Model predict the three lightest electroweakinos, χ_2^0, $\chi_1^\pm$, χ_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 $\Delta m(\chi_2^0, \chi_1^0) > \mathcal{O}(1\,\text{GeV})$ 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, mass splittings in the range of $\Delta m(\chi_1^\pm, \chi_1^0) = 0.3 - 1.0\,\text{GeV}$ are still unexplored at the LHC.

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

T 9.3 Mon 16:45 T-H22

Search for disappearing tracks with the CMS experiment at $\sqrt{s} = 13$ TeV — •Viktor Kutzner[1], Samuel Bein[1], Seh Wok Lee[2], Sang-Il Pak[2], Peter Schleper[1], and Sezen Sekmen[2] — [1]Institute for Experimental Physics, Hamburg University, Luruper Chaussee 149, D-22761 Hamburg, Germany — [2]Kyungpook National University, Daegu, South Korea

Long-lived heavy particles are often predicted in BSM theories with a small mass splitting between the two lightest new 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 9.4 Mon 17:00 T-H22

Search for Elektroweak Production of Sleptons in Di-Lepton Final States with the ATLAS Detector — •Marian Rendel, Michael Holzbock, Hubert Kroha, and Sandra Kortner — Max-Planck-Institut für Physik (Werner-Heisenberg-Institut)

Supersymmetry (SUSY) is one of the best studied extensions of the Standard Model (SM) and as such a major part of the ATLAS physics program. SUSY scenarios with light scalar partners of the SM leptons (sleptons) and the neutralino as lightest SUSY particle (LSP) may address the observed muon g-2 anomaly, as well as provide a viable candidate for Dark Matter, and are thus of particular interest. The kinematic properties of final states in events with pair-produced sleptons primarily depend on the mass splitting (Δm) between the sleptons and the LSP. Two complementary ATLAS searches targeting large and small mass splittings, respectively, have been published. However, there remains a sensitivity gap in the intermediate region of moderate mass splittings between 20 GeV and 60 GeV.

In this talk, a new search for sleptons in events with an electron or muon pair produced with an initial–state radiation jet, is presented which particularly aims at closing the sensitivity gap.

The design of the signal region and the background estimation strategies are introduced and the expected sensitivity using 139 fb^{-1} LHC proton–proton collision data collected by the ATLAS experiment during the years of 2015 and 2018 is presented.

T 9.5 Mon 17:15 T-H22

Search for supersymmetry in single lepton events with the full Run 2 data — •Frederic Engelke[4,5], Kerstin Borras[4,5], Kimmo Kallonen[3], Henning Kirschenmann[3], Pantelis Kontaxis[1], Dirk Krücker[4], Isabell Melzer-Pellmann[4], Ashraf Mohammed[4,5], Paris Sphicas[1,2], Costas Vellidis[1], and Lucas Wiens[4] — [1]University of Athens — [2]CERN — [3]Helsinki Institute of Physics — [4]DESY — [5]RWTH Aachen IIIA

Results are presented from a search for supersymmetry in events with a single electron or muon, and multiple hadronic jets. The data corresponds to a sample of proton-proton collisions at $\sqrt{s} = 13$ TeV with an integrated luminosity of 138 fb^{-1}, recorded by the CMS experiment at the LHC.

We use the angular correlation between the lepton and the W boson's transverse momenta for a strong separation between the signal and the background region. The investigation of the two different signal models benefits from improved top and W tagging methods.

The search targets gluino pair production, where the gluinos decay into the lightest supersymmetric particle (LSP) and either a top quark-antiquark pair or a pair of light quarks in the final state.

T 9.6 Mon 17:30 T-H22

Reconstruction of the displaced τ for the long-lived τ slepton searches at CMS — •Mykyta Shchedrolosiev[1], Konstantin Androsov[2,3], Andrea Cardini[1], Dirk Krücker[1], and Isabell Melzer-Pellmann[1] — [1]DESY, Hamburg, Germany — [2]École polytechnique fédérale de Lausanne — [3]ETH Zurich

Supersymmetric scenarios with long-lived tau sleptons are well motivated, e.g. within gauge mediated symmetry breaking scenarios. Direct searches of $\widetilde{\tau} \to \tau\widetilde{\chi}_0^1$ are limited by the reconstruction efficiency of displaced tau leptons at CMS that are produced up to 50 cm away from the IP. In our study, we explore the optimization of the displaced τ lepton reconstruction using deep neural networks for the corresponding stau searches.

T 9.7 Mon 17:45 T-H22

Constraints on Supersymmetry from Collider Searches and Other Experiments — Samuel Bein, •Malte Mrowietz, and Peter Schleper — Universität Hamburg, Institut für Experimentalphysik

Constraints from 13 TeV LHC searches for supersymmetry and other experiments on the minimal supersymmetric standard model (MSSM) are evaluated in the context of the 19-parameter phenomenological MSSM (pMSSM). Complementarity and possible tension between the LHC data, the recent g-2 result, and direct detection experiments are examined.

T 9.8 Mon 18:00 T-H22

Study of the chargino discovery at FCC-hh and inner tracker proposition — •Cédrine Hügli — DESY, Zeuthen, Germany

The Standard Model has been shown to be an incomplete theory. The most popular theory beyond the SM is Supersymmetry (SUSY). Up to now, no evidence for any of the SUSY particles was found, it was only possible to set exclusion regions and limits on their properties. The post LHC era Future Circular Collider (FCC) with a center of mass energy of 100 TeV could be a new possibility to find SUSY particles. In this work the discovery potential of the pure wino (higgsino) with mass 3 TeV (1 TeV) and average lifetime 0.2 ns (0.023 ns) at FCC-

hh is studied in the context of the Minimal Supersymmetric Standard Model with Anomaly Mediated Supersymmetry breaking ($\tan(\beta) = 5$, $m_0 = 20$ TeV and $sign(\mu) > 0$). Using simulations of minimum bias events and single chargino interactions in the reference design of the tracker, the fake rate is estimated. Additionally, the influence of the tracker performance on the discovery potential is studied. The fake rate is then used to predict the final discovery potential of the wino (higgsino) at FCC-hh. The possible mass reach for charginos at FCC-hh is found and the mass prediction possibility is studied.

T 9.9 Mon 18:15 T-H22

SUSY at future colliders - an overview — •Mikael Berggren — Deutsches Elektronen-Synchrotron DESY, Notkestr. 85, 22607Hamburg

A study of the prospects for discovering or excluding SUSY at various proposed future colliders is presented. The study is based on scanning the relevant parameter space of (weak-scale) SUSY parameters. In particular, I concentrate on the properties most relevant to evaluate the experimental prospects: mass differences, lifetimes and decay-modes. The observations are then confronted with estimated experimental capabilities, including - importantly - the detail of simulation these estimates are based upon. Conclusions on realistic prospects are presented.