

## T 81: Supersymmetrie II

Zeit: Donnerstag 16:00–18:30

Raum: S07

T 81.1 Do 16:00 S07

**Suche nach Supersymmetrie in Endzuständen mit Photonen und einem Z Boson bei CMS** — ●SEBASTIAN WUCHTERL, LUTZ FELD und JOHANNES SCHULZ — I. Physikalisches Institut B, RWTH Aachen University

Supersymmetrie ist eines der vielversprechendsten Modelle zur Ergänzung des Standardmodells der Teilchenphysik. In Szenarien, in denen die Symmetriebrechung durch Eichbosonen vermittelt wird (GMSB), werden Endzustände mit Photonen ( $\gamma$ ) und Gravitinos ( $\tilde{G}$ ), hier das leichteste supersymmetrische Teilchen, vorhergesagt, die sich aufgrund der Undetektierbarkeit der Gravitinos in fehlendem transversalem Impuls im Detektor ( $p_T^{\text{miss}}$ ) niederschlagen. Auch andere Bosonen können im Zerfall des zweitleichtesten Teilchens, dem Neutralino ( $\chi_1^0$ ), entstehen,  $\chi_1^0 \rightarrow \tilde{G} + \gamma/Z$ .

Es wird eine Suche präsentiert, die Daten untersucht, die 2016 in Proton-Proton Kollisionen bei einer Schwerpunktsenergie von 13 TeV vom CMS-Detektor aufgezeichnet wurden und einer integrierten Luminosität von  $36\text{fb}^{-1}$  entsprechen. In der Analyse werden Endzustände mit einem Photon und zwei Leptonen gleicher Familie und unterschiedlicher elektrischer Ladung selektiert. Die Ergebnisse in dem bisher nicht untersuchten Endzustand werden in GMSB und vereinfachten Modellen interpretiert und Ausschlussgrenzen berechnet.

T 81.2 Do 16:15 S07

**Signal Optimisation Strategies for Direct Pair Production of Scalar Tau Leptons with the ATLAS Detector in Run 2** — ●CLARA LEITGEB, ALEXANDER MANN, and FERDINAND KRIETER — Ludwig-Maximilians-Universität München

Supersymmetry is a promising extension of the Standard Model of particle physics. The direct pair production of scalar tau leptons ( $\text{staus}$ ) and their subsequent decay into a tau lepton and the lightest neutralino is searched for with the ATLAS detector at the LHC. Because of the very low expected cross section, a search for this process in the first run of the LHC at 8 TeV center-of-mass energy could hardly reach any sensitivity. But the increased center-of-mass energy of 13 TeV in run 2 results in a higher cross section for this process. Together with the large integrated luminosity of  $140\text{fb}^{-1}$  this significantly improves the prospects for the detection of stau pairs. Furthermore, the identification of tau leptons has been improved in run 2. However, there is also an increase of the cross sections of some Standard Model background processes. In addition, the trigger selection becomes more difficult due to the higher instantaneous luminosity and pile-up.

In this talk, the search for direct stau production with the full dataset recorded by ATLAS at a center-of-mass energy of 13 TeV will be presented. The main focus will be on the design of optimal signal regions, for which a cut-and-count approach is used in two distinct regions of phase space.

T 81.3 Do 16:30 S07

**Search for Supersymmetry in final states with opposite-sign same-flavor lepton pairs,  $p_T^{\text{miss}}$ , and jets using data taken with the CMS experiment from 2016 to 2018** — LUTZ FELD and ●MARIUS TEROERDE — I. Physikalisches Institut B, RWTH Aachen, Aachen, Germany

Supersymmetry (SUSY) is an extension of the Standard Model (SM) of particle physics with the potential to solve several problems of modern physics by introducing superpartners of all SM particles. In the presented analysis, the production of opposite-charge same-flavor lepton pairs along with jets and stable, undetected SUSY particles is considered.

The presented search is performed on data taken by the CMS detector at the Large Hadron Collider at  $\sqrt{s} = 13\text{TeV}$  in the years 2016 to 2018, amounting to an integrated luminosity of  $140\text{fb}^{-1}$ .

T 81.4 Do 16:45 S07

**Suche nach Topsquarkpaarproduktion in Endzuständen mit einem Lepton am ATLAS-Experiment** — ●JULIAN WOLLRATH und FREDERIK RÜHR — Physikalisches Institut, ALU Freiburg

Mit dem ATLAS-Experiment wurden bei einer Schwerpunktsenergie von  $\sqrt{s} = 13\text{TeV}$   $140\text{fb}^{-1}$  an Daten aufgenommen. Dieser Vortrag berichtet über die Suche nach Topsquarkpaarproduktion in Endzuständen mit einem Lepton in diesem Datensatz, und die zu erwartenden

Verbesserungen gegenüber der schon bestehenden Suche mit  $36\text{fb}^{-1}$  an Daten durch Entwicklung neuer sensitiver Variablen. Dabei wird angenommen, dass ein hundertprozentiges Verzweigungsverhältnis von  $t_1 \rightarrow t^{(*)}\tilde{\chi}_1^0$  besteht und dass  $m(\tilde{t}_1) \approx m(t) + m(\tilde{\chi}_1^0)$  gilt.

T 81.5 Do 17:00 S07

**Searches for New Physics at the CMS Experiment Using Advanced Techniques for Lepton Reconstruction** — SAMUEL BEIN, VIKTOR KUTZNER, YUVAL NISSAN, PETER SCHLEPER, and ●ALEXANDRA TEWS — Universität Hamburg, Deutschland

A variety of supersymmetric extensions of the Standard Model lead to low-mass Higgsinos with compressed mass spectra. Searches for SUSY in events with two low-momentum opposite-sign leptons as well as searches for disappearing tracks are particularly sensitive to such SUSY models.

A new data-driven method to determine lepton track reconstruction efficiencies in CMS is presented. This method is used in searches for disappearing tracks, which target compressed Higgsino models with mass differences among the Higgsinos of order of  $1.4 - 10\text{GeV}$ .

In addition, we consider the case of the production of Higgsino-like electroweakinos, e.g.  $\chi_1^\pm, \chi_2^0$ , where 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 extremely compressed (nearly degenerate). Progress is reported on new methods for reconstructing low-momentum, displaced lepton pairs, which may be key in targeting the compressed, unexplored regions of the model phase space.

T 81.6 Do 17:15 S07

**Fake Background Estimation for the Search for Supersymmetry in Multileptonic Final States with the ATLAS Detector** — ●MARIAN RENDEL, ZINONAS ZINONOS, and HUBERT KROHA — Max Planck Institut für Physik (Werner-Heisenberg-Institut)

The search for supersymmetry (SUSY) is a major part of the ATLAS physics program. Due to the low Standard Model (SM) background, the search for final states with four or more charged leptons provides excellent sensitivity to various supersymmetric scenarios. Nevertheless, several SM processes lead to signatures resembling SUSY signals with four reconstructed charged leptons, including real and fake lepton contributions. In contrast to real leptons, fake leptons are non-prompt or non-isolated and originate from semileptonic hadron decays or are due to misidentification of particles or jets. Therefore, the background can be classified into two categories: The irreducible background, from processes with four or more real leptons, and the reducible background with at least one fake lepton. In this talk the methods for estimating the reducible background is discussed.

T 81.7 Do 17:30 S07

**A run-II CMS pMSSM interpretation** — SAMUEL BEIN, ●MALTE MROWIETZ, PETER SCHLEPER, and JORINE SONNEVELD — Institut für Experimentalphysik, Universität Hamburg

Constraints on new physics from collider searches are usually presented in terms of so-called simplified models. However, because simplified models only consider a very small number of degrees of freedom of a more complete fundamental extension of the standard model, they are likely to provide an incomplete picture. To evaluate the impact of new physics searches more broadly, interpretations are made in terms of full models like the phenomenological Minimal Supersymmetric Standard Model (pMSSM). An integral part of such an analysis is a scan of the parameter space. In this talk, results from previous pMSSM scans are reviewed and a new parameter scan is presented as the basis of a run II pMSSM interpretation by the CMS experiment.

T 81.8 Do 17:45 S07

**Search for squarks and gluinos in final states with jets and missing transverse momentum with the ATLAS detector** — ●VERONIKA MAGERL — Albert-Ludwigs-Universität Freiburg

Many extensions of the Standard Model (SM) include heavy coloured particles, such as the squarks and gluinos of supersymmetric (SUSY) theories, which could be accessible at the Large Hadron Collider (LHC) and detected by ATLAS. A large number of R-parity-conserving models predict squarks and gluinos produced in pairs and decaying either

directly or in cascades to quarks, neutralinos and eventually leptons.

The neutralino  $\tilde{\chi}_1^0$  is assumed to be the Lightest Supersymmetric Particle (LSP) which escapes undetected, resulting in large missing transverse momentum which, in addition to the jets originating from the quark fragmentation, form the final states investigated in the 0-Lepton SUSY analysis. In order to distinguish these signatures from the SM background it is crucial to have a good estimation of the SM processes resulting in the same final states.

This talk presents the latest results of the ATLAS 0-Lepton SUSY analysis focusing on the techniques of background estimation.

T 81.9 Do 18:00 S07

**Search for Higgsino production in SUSY scenarios with a compressed mass spectrum** — ●YUVAL NISSAN<sup>1</sup>, PETER SCHLEPER<sup>1</sup>, GUDRID MOORTGAT-PICK<sup>2</sup>, and SAM BEIN<sup>1</sup> — <sup>1</sup>University of Hamburg — <sup>2</sup>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 81.10 Do 18:15 S07

**Search for disappearing tracks with the CMS experiment at  $\sqrt{s} = 13$  TeV** — ●VIKTOR KUTZNER<sup>1</sup>, SAMUEL BEIN<sup>1</sup>, SEH WOK LEE<sup>3</sup>, ISABELL MELZER-PELLMANN<sup>2</sup>, SANG-IL PAK<sup>3</sup>, ALEXANDRA TEWS<sup>1</sup>, PETER SCHLEPER<sup>1</sup>, SEZEN SEKMEN<sup>3</sup>, AKSHANSH SINGH<sup>2</sup>, JORY SONNEVELD<sup>1</sup>, GEORG STEINBRÜCK<sup>1</sup>, and BENEDIKT VORMWALD<sup>1</sup> — <sup>1</sup>Institut für Experimentalphysik, Universität Hamburg — <sup>2</sup>DESY — <sup>3</sup>Kyungpook National University

Long-lived charginos are predicted in theories with a small mass splitting between the two lightest particles, such as anomaly-mediated supersymmetry breaking (AMSB). Here, the two lightest particles are typically a chargino and a neutralino. 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 disappearing track. This signature is characterized by missing hits in the outer layers of the tracker with little or no energy deposited in the calorimeter. The search includes short disappearing tracks with only a few hits in the tracking detector, as well as events with several jets and disappearing tracks. Events with b-quark jets are investigated as well to account for gluino-/squark-associated chargino production. Disappearing tracks are identified using a boosted decision tree, and 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.