T 36: Supersymmetrie I

Zeit: Dienstag 16:00–18:30 Raum: S11

T 36.1 Di 16:00 S11

Suche nach Supersymmetrie mit versetzten Leptonpaaren beim ATLAS-Experiment am LHC — •Dominik Krauss, Zinonas Zinonos und Hubert Kroha — Max-Planck-Institut für Physik, München

Die meisten Suchen nach Supersymmetrie am LHC konzentrieren sich auf den Fall, dass das leichteste supersymmetrische Teilchen stabil und die anderen supersymmetrischen Teilchen kurzlebig sind. Bisher sind diese Suchen jedoch erfolglos geblieben und daher wird es immer wichtiger auch supersymmetrische Modelle zu betrachten, in denen diese Annahmen nicht erfüllt sind. Einige dieser Modelle sagen langlebige supersymmetrische Teilchen voraus, die in geladene Leptonen zerfallen. Liegt deren Lebensdauer im Bereich von Pikosekunden bis Nanosekunden, können deren Zerfälle als sekundäre Vertizes im Innendetektor rekonstruiert werden. Da das Standardmodell solche Zerfälle nicht vorhersagt, gibt es nur einen geringen Untergrund, der es ermöglicht, selbst schwache Signale in den Daten auszumachen. In diesem Vortrag wird eine Suche nach solchen versetzten Vertizes mit geladenen Leptonen am ATLAS-Experiment vorgestellt.

T 36.2 Di 16:15 S11

Combination of Searches for gauge-mediated Supersymmetry in Events with Photons at CMS — Christian Autermann, Lutz Feld, Johannes Schulz, Marius Teroerde, and •Danilo Meuser — I. Physikalisches Insitut B, RWTH Aachen University

Supersymmetry is one of the most popular extensions to the standard model of particle physics, providing possible solutions to problems such as the hierarchy problem or the unification of forces. In the context of gauge-mediated supersymmetry the rate of events with photons in the final state can be enhanced. This motivates searches in events with photons and missing transverse momentum due to the undetected lightest supersymmetric particle.
This analysis combines searches for gauge-mediated supersymmetry in events with at least one photon. The combination is based on proton-proton collision data recorded by CMS in 2016, which corresponds to a center-of-mass energy of 13 TeV and an integrated luminosity of 35.9 fb^{-1}. Four individual analyses, which all focus on signatures with isolated photons and a significant amount of missing transverse momentum, are combined to cover a wide range of different signal scenarios. These signatures are complemented by additional charged leptons, a second photon, or additional requirements on the hadronic activity. Within the analysis, possible overlaps between the different signal regions are removed by an optimized veto strategy. The combination of searches probes the phase space of gauge-mediated scenarios and improves the exclusion limits derived by the individual analyses.

T 36.3 Di 16:30 S11

Search for stau pair production in proton-proton collisions at the LHC with the ATLAS detectors — •Patrick Selle, Zinonas Zinonos, and Hubert Kroha — Max Planck Institut für Physik, München, Deutschland

Supersymmetry (SUSY) provides solutions to many open problems of the Standard Model (SM) such as the hierarchy problem and the mystery of Dark Matter (DM). In certain SUSY models, the supersymmetric partner of the τ-lepton, the stau ($\tilde{\tau}$), is expected to be lighter than other sleptons, such that its mass could be at the electroweak scale. Models involving coannihilation between the stau and the lightest supersymmetric particle (LSP), which can be almost mass-degenerate, can reproduce the relic DM density of the universe as measured by cosmological observations. At the LHC, staus would be pair-produced and decay into their SM counterpart and the LSP. Typical stau events would therefore be characterized by the presence of SM tau leptons and the production of significant missing energy arising from the LSP pair and the neutrinos from the tau decays. This talk presents the strategy for searching for stau-pair production in final states with one hadronically decaying and one leptonically decaying tau lepton. The analysis relies on data using events in the ATLAS detector. Multivariate analysis techniques are applied to achieve the highest possible signal sensitivity.

T 36.4 Di 16:45 S11

Search for top squark pair production in final states with one lepton using 140 fb^{-1} **of** $\sqrt{13}$ TeV **data with the ATLAS experiment** — •David Handl and Jeannine Wagner-Kuhr — LMU München

Natural supersymmetry models favour a relatively light supersymmetric partner of the top quark referred to as the top squark ($\tilde{t}_1$), with a mass predicted up to a few TeV.
A search for top squark pair production in events with exactly one electron or muon, multiple jets and missing transverse momentum is presented. The analysis is performed using data from proton-proton collisions recorded at a center-of-mass energy of $\sqrt{13}$ TeV by the ATLAS experiment corresponding to an integrated luminosity of 140 fb^{-1}. This talk focuses on decay scenarios where the mass difference between the top squark and the neutralino ($\tilde{\chi}_1^0$) is smaller than the top quark ($\Delta m \equiv m_{\tilde{t}_1} - m_{\tilde{\chi}_1^0} < m_t$). In this phase-space, the top squark pair events closely resemble top quark pair processes, which make dedicated searches difficult. However, it will be shown that a substantial discrimination between signal and background processes can be achieved using machine learning techniques. In the following, the analysis strategy based on neural networks is presented, search regions and background estimation are defined and the sensitivity reach is discussed.

T 36.5 Di 17:00 S11

QCD background estimation for the search of top squarks with 1-lepton in the final state with ATLAS — •Arrubarrena Paola, Handl David, and Wagner-Kuhr Jeannine — LMU, Munich, Germany

Supersymmetry (SUSY) is an extension of the standard model of particle physics which predicts a supersymmetric partner for each particle in the standard model. If R-parity is conserved, then the lightest supersymmetric particle (LSP) is stable and a good dark matter candidate. In many models the LSP is favored to be the lightest neutralino ($\tilde{\chi}_1^0$), and the SUSY partner of the top quark, top squark ($\tilde{t}_1$), is usually assumed to be light and in the reach of the LHC. In this talk studies on QCD multijet background estimation for the full Run-2 analysis, using *pp* collision data at a center of mass energy of 13 TeV recorded with the ATLAS detector from 2015 to 2018, are presented.

In this analysis, QCD multijet background originates from jets or non-prompt leptons that mimic the isolated lepton criteria and hence are wrongly selected. In particular for signal regions targeting small $\Delta m = (m_{\tilde{t}_1} - m_{\tilde{\chi}_1^0})$, which are characterized by low-energy leptons, the QCD background is expected to be larger and a quantitative evaluation of the QCD background in these regions is essential. In this talk the estimation of the QCD multijet background via a data-driven fake-factor method is presented.

T 36.6 Di 17:15 S11

Search for electroweak production of supersymmetric states in compressed mass spectra in Run 2 with the ATLAS detector — •Michael Holzbock and Alexander Mann — Ludwig-Maximilians-Universität München

Supersymmetry (SUSY) is one of the best studied extensions of the Standard Model. Although there is no sign of physics beyond the Standard Model yet, SUSY could still be hiding in more challenging signatures, like compressed mass spectra. These scenarios involve small mass differences between heavier SUSY particles and the lightest supersymmetric particle leading to the appearance of soft objects in the decay chain.

A search is presented in which the lightest electroweakino states are nearly mass degenerate, leading to final states with two soft leptons, that have transverse momentum typically in the range from 3 to 20 GeV. These events are selected using triggers on missing transverse momentum ($\text{E}_\text{T}^\text{miss}$) that originates from the SUSY system recoiling against a jet from initial state radiation. To avoid any bias due to mismodeling in simulation, the usage of these triggers usually requires a hard cut on $\text{E}_\text{T}^\text{miss}$ at analysis level, which causes a significant loss in signal acceptance. Measuring the trigger efficiencies in data and simulation allows for an analysis selection with less tight requirements on $\text{E}_\text{T}^\text{miss}$ and thus to recover a considerable fraction of the signal events.

This talk comprises studies about the measurement of the trigger efficiencies and how the inclusion of the low $\text{E}_\text{T}^\text{miss}$ phase space enhances the sensitivity of the search in a statistical combination.

T 36.7 Di 17:30 S11

ATLAS sensitivity to higgsinos with a highly compressed mass spectrum at the HL-LHC — •Jorge Andres Sabater[1], Federico Meloni[1], Simone Amoroso[1], Brian Petersen[2], and Peter Tornambe[3] — [1]DESY — [2]CERN — [3]Freiburg University

Supersymmetry (SUSY) is a symmetry that introduces a relation between every Standard Model (SM) fermion and gauge boson with a superpartner state whose spin differs by half a unit. In the Minimal Supersymmetric extention of the SM (MSSM), the fermionic superpartners of the electrically neutral gauge bosons, the bino and the wino, mix with the Higgsinos, to form four neutralinos and two charginos physical mass eigenstates, often referred to as electroweakinos.

The talk will present the exclusion reach and discovery potential for direct electroweakino pair production in models with small mass differences between the lightest SUSY particle (LSP) and the second LSP at the High Luminosity LHC (HL-LHC). The electroweakinos decay via off shell W and Z bosons, resulting in a final state with two charged leptons, jets and missing transverse momenta coming from the undetected LSP. The analysis is done simulating the ATLAS detector performance in the HL-LHC regime where 200 interactions per bunch crossing will be reached and the amount of data collected will be 20 times greater than the present one. The results show a sensitivity improvement with the increased amount of data, leaving some room for possible SUSY discovery, and they also serve as a good complementarity with other future HL-LHC analyses.

T 36.8 Di 17:45 S11

Search for electroweakinos in events with one lepton with the ATLAS detector at the LHC — •Eric Schanet and Jeanette Lorenz — Ludwig-Maximilians-Universität München

Supersymmetry is a promising extension of the Standard Model of Particle Physics (SM) as it provides a solution to some of the open questions of the SM. If squarks and gluinos are beyond the reach of the LHC, the production of charginos and neutralinos could be the dominant production mode of supersymmetric particles in $\sqrt{s} = 13$ TeV pp collisions at the LHC.

In this talk, a search for the production of charginos and neutralinos, using 140 fb^{-1} of pp collisions recorded from 2015 to 2018 by the ATLAS detector, is presented. In the signal scenario considered, the chargino decays via $\tilde{\chi}_1^{\pm} \to W\tilde{\chi}_1^0$ while the neutralino decays through $\tilde{\chi}_2^0 \to h\tilde{\chi}_1^0$. In many events, the final state of this signal scenario is thus characterised by the presence of exactly one lepton from $W^{\pm} \to \ell^{\pm}\nu$, two b-jets from the Higgs decay and missing transverse momentum, providing high discrimination against SM background processes. In this talk, the analysis strategy in this decay channel as well as the signal regions optimisation and the sensitivity projections will be presented.

T 36.9 Di 18:00 S11

Searches for $\tilde{\tau}$-production with the ATLAS experiment — •Johannes Junggebburth, Hubert Kroha, and Zinonas Zinonos — Max-Planck Institut für Physik, München

The search for Supersymmetry is a broad topic of the ATLAS research programme. Direct $\tilde{\tau}$ pair production is a channel on which the last limits were put at the era of LEP. Once produced, the $\tilde{\tau}$ decays into a τ-lepton and a $\tilde{\chi}_1^0$. The latter is an ideal Dark Matter candidate and if the $\tilde{\tau}$ is light enough, it naturally explains the observed dark-matter abundance. However, τ reconstruction itself is very challenging due to the large QCD background, motivating to exploit the use of machine-learning techniques. This talk presents the search strategy for direct $\tilde{\tau}$ production where one τ decays into hadrons and other one leptonically using machine-learning techniques. The expected sensitivity in the LHC Run-2 dataset comprising 150 fb^{-1} will be discussed and compared to a cut-based approach.

T 36.10 Di 18:15 S11

A data-driven multijet background estimation method for the search for direct pair production of scalar tau leptons with the ATLAS detector — •Ferdinand Krieter, Alexander Mann, and Clara Leitgeb — Ludwig-Maximilians-Universität München

As a proposed fundamental symmetry of nature, Supersymmetry provides elegant solutions to various open questions of the Standard Model by predicting superpartners of known particles, whose spins differ by one half unit. In R-parity-conserving models, these hypothetical particles are produced in pairs and decay ultimately into the stable, lightest supersymmetric particle, a candidate for dark matter. A search for direct production of scalar tau leptons in final states with two hadronically decaying tau leptons and missing transverse momentum is presented. The simplified signal models consider scalar tau leptons decaying exclusively into a tau lepton and a stable neutralino. Such a production mode may dominate if the strongly interacting superpartners and gauginos are heavy and thus beyond the reach of currently probed energy scales. The analysis uses pp collision data at a center-of-mass energy of 13 TeV, recorded with the ATLAS detector from 2015 to 2018. The background for the investigated signature is dominated by multijet production via the strong interaction, where jets fake the detector signature of a hadronically decaying tau lepton. For the estimation of this background a data-driven fake-factor method is presented.