T 10: Suche nach Dunkler Materie 1 (LHC)

Zeit: Montag 16:45–18:45 Raum: VSH 116

T 10.1 Mo 16:45 VSH 116

Search for Dark Matter in Vector Boson Fusion- and Monojet-Topologies with the ATLAS Experiment at 13 TeV — •Manuel Patrice Geisler — Kirchhoff-Institut für Physik, Heidelberg

The nature of Dark Matter (DM) is one of the big open questions in modern physics. Although the cosmological evidence is strong, the nature of DM has yet to be unraveled. This talk covers a new search for DM with the ATLAS detector at CERN using the 2015 dataset of proton-proton collisions. As DM particles would escape the detector without leaving any trace, their production in association with quarks and gluons can result in significant amounts of missing transverse momentum (MET). Two high-MET final states are investigated, which differ in jet kinematics and minimum number of required jets (1-jet and 2-jet) and which are designed to be a generic as possible. Additionally, the 2-jet final state is particularly sensitive to vector boson fusion. In this talk, general aspects of the search as well as details on background estimations will be covered.

T 10.2 Mo 17:00 VSH 116

Suche nach Dunkler Materie im Mono-Higgs-Kanal mit dem ATLAS-Detektor bei einer Schwerpunktenergie von 13 TeV — •Rainer Röhrig, Sandra Kortner, Hubert Kroha und Patrick Rieck — Max-Planck-Institut für Physik, München, Deutschland

Dunkle Materie dominiert die Materie im Universum und ist einer der wichtigsten Hinweise auf Physik jenseits des Standardmodells. Die Teilchennatur der Dunklen Materie ist bisher unbekannt, jedoch wird vermutet, dass sie aus massiven schwach wechselwirkenden Elementarteilchen bestehen könnte. Solche Teilchen können am LHC erzeugt und im ATLAS-Detektor in Ereignissen mit hoher fehlender transversaler Energie beobachtet werden. Die Paarproduktion von Teilchen der Dunklen Materie mit einem Higgs-Boson ($pp \to h + \chi\bar{\chi}$) in pp-Kollisionen im sogenannten Mono-Higgs-Kanal liefert eine neue Signatur für Dunkle Materie, wonach nach der Entdeckung des Higgs-Bosons an Beschleunigern gesucht werden kann. Am vielversprechendsten ist dabei die Suche im Endzustand mit Higgs-Bosonzerfällen in $b\bar{b}$-Paare. Die Higgs-Bosonen werden hier mit hohen Impulsen erzeugt, was zu einer starken Kollimation der beiden b-Quarks im Endzustand führt, die daher als ein gemeinsamer Hadron-Jet mit großem Radiusparameter rekonstruiert werden. Die Substruktur solch großer Jets liefert zusätzliche Kriterien zur Unterdrückung des Untergrunds. Für die Suche nach Mono-Higgs-Ereignissen bei erhöhter Schwerpunktsenergie des LHC wurde die Sensitivität für verschiedene Signalmodelle untersucht und die aufgenommenen Daten der Jahre 2015 und 2016 analysiert.

T 10.3 Mo 17:15 VSH 116

Sensitivity optimisation of the search for Dark Matter produced in association with a Higgs boson decaying to a pair of b quarks with the ATLAS detector at $\sqrt{s}$=13 TeV using 36 fb-1 of data — •Daniel Narrias-Villar — Heidelberg University, Im Neuenheimer Feld 227, 69120 Heidelberg

The recent discovery of the Higgs boson motivates collider-based searches for new physics models, where Dark Matter is produced in association with a Higgs boson. The signature of this search is a pair of b quarks from the Higgs boson decay, recoiling against missing transverse momentum from Dark Matter particle(s). To increase the sensitivity of the search, various studies are performed and applied in the analysis. The dominant background from ttbar production is reduced by about 70% for a signal loss of about 10%; as a result the irreducible background from Z(vv)+jets production became the dominant background contribution. These improvements result in a substantial increase of sensitivity of up to 50%. In case of no significant excess, limits at 95% confidence level over a parameter phase space of signal models will be provided using 36 fb-1 of data.

T 10.4 Mo 17:30 VSH 116

From the trigger to model-independent limits: A search for Dark Matter produced in association with a Higgs boson decaying to a pair of $b-$quarks with the ATLAS detector at $\sqrt{s}$ = 13 TeV using 36 fb^{-1} of data — •Stanislav Suchek and Oleg Brandt — Kirchhoff-Institut für Physik, Universität Heidelberg

Cosmological observations combined with the recent discovery of the Higgs boson motivate collider-based searches for new physics models, where Dark Matter is produced in association with a Higgs boson. This search focuses on the signature of a pair of $b-$quarks from the Higgs boson decay and missing transverse momentum from Dark Matter particle(s). One of the challenges of this analysis is the missing transverse energy trigger. Its performance in 36 fb^{-1} of data collected by the ATLAS detector in 2015 and 2016 is studied. A particular focus is placed on the low missing transverse energy region, where triggers are not fully efficient, and Monte Carlo-to-data corrections are derived. Furthermore, trigger efficiencies are calculated for different signal models, such as Z'-2HDM and effective field theories. In case of no significant excess, model-independent limits at 95% confidence level on $\sigma \times A \times \epsilon$, the combination of production cross-section of potential new physics processes, detector acceptance, and the reconstruction efficiency, will be presented for different missing transverse energy regions.

T 10.5 Mo 17:45 VSH 116

Dark Matter search in connection with top quark pair production — •Nicole Stefanov, Christian Schwanenberger, Kelly Beernaert, Gerrit Van Onsem, Alexander Grohsjean, and Afiq Aizuddin Anuar — DESY, Hamburg

There are hints on dark matter from astrophysical observations since the early 20th century. To explain the observed rotation velocity of galaxies with the Newtonian law of gravity, more matter needs to be present than the visible one. Otherwise galaxies would fly apart into their individual components. Today over 80 percent of the total matter of the universe is assumed to be dark matter and the origin of dark matter is completely unknown.

At the CERN Large Hadron Collider we search for dark matter using data from the CMS experiment. In this talk I present a search for dark matter in association with top quark pair production.

Tools and methods how to increase the sensitivity in extracting dark matter events from the obtained data will be discussed.

T 10.6 Mo 18:00 VSH 116

Search for dark matter in events with a Z boson and missing transverse energy at CMS — •Andreas Albert, Thomas Hebbeker, and Arnd Meyer — III. Physikalisches Institut A, RWTH Aachen University, Aachen

Understanding the origin of dark matter (DM) is one of the most pressing tasks in physics today. As ample astrophysical evidence has shown, DM occupies a significant fraction of the cosmological energy budget, for which the standard model of particle physics cannot account. If DM consists of particles, it may be produced in particle collisions.

A search for dark matter in proton-proton collision events with a center-of-mass energy of 13 TeV at the CERN LHC is presented. The analysis is based on a dataset corresponding to an integrated luminosity of approximately 36/fb collected in the CMS experiment in 2016. Since hypothetical DM particles would not be directly detectable in CMS, events with large missing transverse energy (MET) are selected. Additionally, a muon or electron pair compatible with the decay of a Z boson from initial state radiation is required in order to select a well-defined topology. A shape analysis of the MET spectrum then allows to search for a signal.

In addition to DM production, the search can be interpreted in terms of other new physics phenomena producing undetectable particles, such as unparticles and gravitons.

Following an introduction to the analysis concepts, recent developments in the used experimental techniques and results of the analysis are presented.

T 10.7 Mo 18:15 VSH 116

Search for Dark Matter in association with a hadronically decaying vector boson in pp collisions at $\sqrt{s}$ = 13 TeV using 2015+2016 data collected with the ATLAS detector — •Xuanhong Lou — Deutsches Elektronen-Synchrotron, 22607 Hamburg, Germany

We present a search for Dark Matter pair production in association with a hadronically decaying vector boson using 36 fb^{-1} of pp collisions at $\sqrt{s}$ = 13 TeV recorded by the ATLAS detector at the Large Hadron Collider. Events are characterized by large missing transverse

momentum and a W or Z boson reconstructed as either a pair of small-radius jets or a single large-radius jet with substructure information. The results will be interpreted in terms of simplified models and effective field theories which are used to describe the interaction between Dark Matter and the Standard Model particles. The data are consistent with the Standard Model predictions and no statistically significant excess is observed.

T 10.8 Mo 18:30 VSH 116

Suche nach Dunkler Materie in Assoziation mit einem hadronisch zerfallenden W- oder Z-Boson mit den Run-2-Daten des ATLAS-Detektors — •Philipp Gadow, Sandra Kortner, Hubert Kroha und Patrick Rieck — Max-Planck-Institut für Physik (Werner-Heisenberg-Institut), München

Die Existenz Dunkler Materie wird durch zahlreiche astrophysikalische Hinweise untermauert, jedoch steht ein Nachweis der genauen Teilchennatur noch immer aus. Hypothetische Teilchen der Dunklen Materie können in pp-Kollisionen am LHC in Paaren gemeinsam mit Teilchen des Standardmodells erzeugt und so über Signaturen mit fehlendem Transversalimpuls nachgewiesen werden. Dieser Vortrag stellt die Suche nach Dunkler Materie in assoziierter Produktion mit einem hadronisch zerfallenden W- oder Z-Boson vor, basierend auf den Run-2-Daten des ATLAS-Detektors. Die Signalsignatur ergibt sich aus den als Jets rekonstruierten Zerfallsprodukten der Vektorbosonen und dem fehlenden Transversalimpuls der nicht mit dem Detektor wechselwirkenden Teilchen der Dunklen Materie. Bei hoher Geschwindigkeit des Vektorbosons ist es möglich, dass die Zerfallsprodukte als einzelner Jet mit großem Radiusparameter rekonstruiert werden. Bei der Identifizierung der Vektorbosonen kommen daher Jet-Substruktur Techniken zum Einsatz. Die Ergebnisse werden im Rahmen von vereinfachten Modellen sowie einer effektiven Feldtheorie interpretiert.