T 95: Searches for Dark Matter III

Time: Thursday 16:00–18:30 Location: Tt

T 95.1 Thu 16:00 Tt

New measurement of the photoelectric absorption cross section near the silicon band gap for dark matter searches — •Matthew Wilson[1,2] and Belina von Krosigk[1] — [1]Universität Hamburg, Hamburg, Deutschland — [2]University of Toronto, Toronto, Canada

Cryogenic silicon as a detection medium is used for various direct dark matter search experiments. Many of these experiments are sensitive to low-mass dark matter candidates that rely directly or indirectly on the temperature-dependent photoelectric absorption cross section of silicon near the band gap. While this cross section data from the literature is lacking, previous dark matter search experiments have attempted to estimate this parameter by extrapolating it from higher temperature measurements. However, discrepancies in the underlying literature data have resulted in dominating systematic uncertainties on dark matter limits. This presentation shows the results of using a novel technique to make a direct, low-temperature measurement of the photoelectric absorption cross section of silicon at energies near the band gap, and discusses the effect this new measurement has on the exclusion limits from various dark matter candidates.

T 95.2 Thu 16:15 Tt

Loop corrections to the power spectrum for massive neutrino cosmologies — Mathias Garny and •Petter Taule — Technical University of Munich

Mapping out the large-scale structure of the Universe is becoming a leading probe for precision cosmology. Current and near future surveys are expected to achieve unprecedented precision, and correspondingly a solid theoretical understanding is required in order to extract valuable information. Considerable efforts have been devoted in the recent years to model the weakly non-linear regime using perturbative methods. In this talk, I will describe an algorithm for computing loop corrections to the matter power spectrum that can be applied to a wide range of extended cosmological models, due to its capability of fully capturing time- and scale-dependence of the underlying fluid dynamics. I apply this framework to quantify the effect of massive neutrinos on the growth of structure, using a two-component fluid model for CDM+baryons and massive neutrinos. Finally, I compare the matter power spectrum at 2-loop in the presence of massive neutrinos obtained from this framework with simplified treatments that only take neutrinos into account linearly.

T 95.3 Thu 16:30 Tt

Constraints to the scotogenic dark matter model from indirect detection with neutrinos — •Raffaela Busse[1], Thede de Boer[2], Alexander Kappes[1], Michael Klasen[2], and Sybrand Zeinstra[2] — [1]Institut für Kernphysik, WWU Münster — [2]Institut für Theoretische Physik, WWU Münster

As our solar system moves through the galactic halo, dark matter can be captured gravitationally in large celestial bodies, leading to a local over-density and therefore an increased neutrino flux upon annihilation. Here we present a study of neutrino signals from scalar WIMP annihilations in the Sun in the framework of the scotogenic minimal dark matter model, which extends the Standard Model by a scalar doublet and a fermion singlet with three generations. The scotogenic model is studied by means of two parameter scans for the IceCube South Pole Neutrino Observatory in its current IC86 configuration. One scan exploits the entire parameter space whereas for the other coannihilations between the scalar and fermions are enforced allowing for higher event rates. The scan results are compared to several experimental limits in order to identify viable points within the model that can produce a detectable neutrino flux in IceCube, and therefore could be used to constrain the scotogenic parameter space with a future IceCube data analysis.

T 95.4 Thu 16:45 Tt

Exploiting W-tagging in a tW+MET signature Dark Matter search with the ATLAS experiment — •Ben Brüers, Paul Moder, Priscilla Pani, Claudia Seitz, and Alvaro Lopez Solis — DESY, Hamburg and Zeuthen, Germany

Dark Matter (DM) remains one of the unrevealed mysteries of the universe. Even though it constitutes $\sim 80\%$ of the matter, considerably little is known about DM, despite it significantly influences the dynamics of galaxies and the expansion of the universe. The search for DM at colliders, probing mainly a particle nature of the unknown matter, marks an important pillar in exploring all possible realisations of DM. From the variety of DM models, this talk will present a search for DM with the ATLAS experiment, where the DM is coupled to the Standard Model (SM) via a pseudo-scalar mediator that is added to a two-Higgs-doublet model (2HDM+a). Being enhanced by a diagram in which a charged Higgs-boson H^+ decays into the mediator and a W-boson, the associated production of DM with a W-boson and a top-quark is considered. The DM leaves a signature of missing transverse energy (MET) in the detector. For heavy H^+, the W-boson is boosted, meaning that if decaying hadronically, the two jets from its decay are merged into one large-radius jet. Since after preselection only few boosted W bosons are expected from the backgrounds, tagging boosted W's appears efficient to distinguish signal and backgrounds. The talk will introduce W-tagging techniques and their performance. Furthermore some first results of the application of W-tagging in the tW+MET analysis will be shown.

T 95.5 Thu 17:00 Tt

Sensitivity of LHC Measurements to Two Higgs Doublet Models with a Pseudoscalar Mediator — •Martin Habedank[1] and Priscilla Pani[2] — [1]Institut für Physik, Humboldt-Universität zu Berlin — [2]Deutsches Elektronen-Synchrotron (DESY)

In the past few years, two Higgs doublet models with a pseudoscalar mediator that couples to Dark Matter have gained increased attention as they offer a fairly minimal route to address the problem of Dark Matter and at the same avoid constraints from direct detection experiments. While they have been repeatedly probed in the LHC search programme, the sensitivity of existing LHC precision measurements to those models is not as well-explored. A study striving to fill that gap has been conducted, employing the Contur toolkit (https://hepcedar.gitlab.io/contur-webpage/) to compare the new physics predictions to LHC measurements. This method offers the additional advantage of allowing to deviate from the commonly addressed benchmark scenarios by broadening the considered parameter ranges. In this talk, the results of that study will be summarised, pointing out the differences to LHC search combinations and lessons to be learned.

T 95.6 Thu 17:15 Tt

Detector-corrected Dark Matter search in topologies with missing energy and jets with the ATLAS detector — •Sebastian Mario Weber — Kirchhoff-Institut für Physik, Heidelberg, Deutschland

A powerful signature for dark matter production at the Large Hadron Collider is large missing transverse energy (MET) from the dark matter particles in association with one or more energetic jets. A Standard Model (SM) process with a similar signature is the Z boson decaying to neutrinos ($Z \rightarrow \nu\nu + jets$).

A measurement of this process is performed by selecting events with energetic jets and MET as well as events which are selected to enhance vector-boson fusion processes. To allow for later comparisons of the measurement with models for physics beyond the SM, detector effects are removed from the data using an iterative unfolding procedure. Experimental and theoretical uncertainties are constrained using a set of control regions. These control regions are based on different boson mediated processes, which ensures a high degree of correlation of the uncertainties between the different regions. A search for deviations from the SM is then performed on the detector-corrected results.

In this talk new results on the signal and control regions are presented.

T 95.7 Thu 17:30 Tt

Search for Dark Matter in hadronic mono-top signatures at CMS — •Michael Wassmer, Ulrich Husemann, and Sebastian Wieland — Institut für Experimentelle Teilchenphysik (ETP), Karlsruher Institut für Technologie (KIT)

A common approach to Dark Matter searches at colliders is to search for deviations in the distribution of missing transverse momentum because of the invisible nature of Dark Matter. Events with large missing

transverse momentum in association with a Standard Model particle provide a clear signature to search for the aforementioned deviations. This signature is often referred to as the mono-X signature. In this talk, an analysis searching for hadronic mono-top signatures, targeting a phase space with large missing transverse momentum in association with a hadronically decaying top quark, is presented. First, a motivation for the mono-top signature and an introduction to the underlying simplified model are given. Then, the analysis strategy is presented. As a conclusion, the current status of the analysis is shown.

T 95.8 Thu 17:45 Tt

Towards a combination of searches for dark matter produced in association with a single top quark or a top quark pair in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector — •Marianna Liberatore — Deutsches Elektronen-Synchrotron DESY, Hamburg and Zeuthen, Germany

Astrophysical observations have provided compelling evidence for the existence of a non-baryonic component of the universe known as Dark Matter (DM). The nature of DM is not well established, but it is often considered to be a Weakly Interacting Massive Particle, characterised by weak-scale interactions with the Standard Model (SM) particles.

A motivation to DM searches at the Large Hadron Collider, and in particular in the ATLAS experiment, is the especially promising possibility that interactions between ordinary matter and DM are mediated by new spin-0 particles that extend the SM with a potential dark sector, to which DM particles belong. Similarly to the Higgs boson, these new mediators interact strongest with the heaviest particles via Yukawa-type couplings, making them more prone to associated production with heavy-flavour quarks.

To test those models, two recently released search channels are considered within ATLAS: DM with top quark pairs[1] or a single top quark[2], with a focus on the two charged leptons final states. Preliminary work aimed at a statistical combination of these two results in more realistic simplified models will be presented in this talk.

[1] ATLAS-CONF-2020-046
[2] arXiv:2011.09308

T 95.9 Thu 18:00 Tt

Detector corrected Dark Matter search with jets and missing transverse energy with the ATLAS experiment — •Martin Klassen — Kirchhoff-Institut für Physik, Heidelberg

Dark Matter (DM) could reveal itself within the ATLAS detector as a signature of missing transverse energy (MET) accompanied by at least one energetic jet. These jets can either originate from initial or final state radiation or can be relics from vector-boson-fusion (VBF) production leading to two distinct signal regions. An irreducible background results from Standard Model (SM) processes for which the Z boson decays into a pair of neutrinos. Hence, a DM search can be performed by studying deviations from the SM prediction of the cross-sections of those measured invisible Z bosons decays. Experimental and theoretical uncertainties are constrained by dedicated control. The result of the measurement is corrected for detector effects. To search for new physics, the detector-correction signal region and control regions are simultaneously fit to the data, including all systematic uncertainties. Multiple observables such as MET, the invariant mass as well as the difference between the azimuthal angle of the two jets with the largest transverse momenta in the VBF phase space are included in this fit. This talk discusses the simultaneous fit and limiting setting for new physics models.

T 95.10 Thu 18:15 Tt

Searching for Dark Matter in top quark production with the CMS experiment — Danyer Perez Adan, Afiq Anuar, Alexander Grohsjean, Jonas Rübenach, Christian Schwanenberger, •Dominic Stafford, and Nicole Stefanov — DESY, Hamburg, Germany

Astronomical observations provide strong evidence that a large proportion of the matter in the universe is "Dark Matter" (DM) not described in the Standard Model (SM) of particle physics. Furthermore, many cosmological models suggest Dark Matter should couple to the SM on the 100 GeV scale, and hence may be produced at the LHC, appearing as missing transverse momentum. We present a search for Dark Matter produced in association with top quarks in the dileptonic channel, with an interaction via a spin-0 mediator. However, the dileptonic channel also includes missing transverse momentum in the SM process due to the presence of neutrinos, and so we introduce novel variables and machine learning techniques to separate signal from background.

This search, which uses the full Run 2 dataset and will be part of the CMS combination across all ttbar final states, is also the first in the dilepton channel to include the single top + DM process, which can greatly aid sensitivity to the highest mediator masses in the search.