T 77: Suche nach dunkler Materie IV

Zeit: Donnerstag 16:30–19:00 Raum: Philo-HS5

Gruppenbericht T 77.1 Do 16:30 Philo-HS5

Latest Dark Matter Results of XENON1T — •Constanze Hasterok — Max-Planck-Institut für Kernphysik

Weakly interacting massive particles (WIMPs) are a very popular explanation for the nature of dark matter. The XENON1T experiment aims for the direct detection of WIMP-nucleon interactions using a dual phase time projection chamber (TPC) with a liquid xenon target of 3.5 tons. With the data taken during the first science run of 34.2 live days the experiment could impose the most stringent upper limit on spin-independent WIMP-nucleon cross-sections with $7.7 \cdot 10^{(-47)}$ cm^2 at a mass of 35 GeV. This unprecedented sensitivity is further exploited in the second science run for which about 7 times more data has been acquired during the course of last year. After an overview on the XENON1T experiment the talk will present the latest WIMP search results and the prospects of the detector upgrade XENONnT.

Gruppenbericht T 77.2 Do 16:50 Philo-HS5

The MAgnetized Disk and Mirror Axion dark matter eXperiment (MADMAX) — •Stefan Knirck for the MADMAX-Collaboration — Max-Planck-Institute for Physics, Munich, Germany

In contrast to WIMPs, light Dark Matter candidates have increasingly come under the focus of scientific interest. In particular the QCD axion is very well motivated, since it was originally introduced to solve another fundamental problem: CP-conservation in strong interactions. Galactic axions and axion-like particles in a strong magnetic field can be converted to photons at boundaries between materials of different dielectric constants. Combining many such surfaces, one can enhance this conversion significantly using constructive interference and resonances. The proposed MADMAX setup containing approximately 80 high dielectric disks in a 10 T magnetic field would probe the well-motivated mass range of 40–400 μeV, a range which is at present inaccessible by existing cavity searches. We explain the foundations of this approach and give an overview over the R&D challanges the newly founded collaboration is facing, concluding with sensitivity estimates for the planned setup.

Gruppenbericht T 77.3 Do 17:10 Philo-HS5

Testing the dark matter hypothesis for the Fermi GeV-excess versus alternative explanations (molecular clouds, millisecond pulsars) — •Leo Bosse, Wim de Boer, Iris Gebauer, Alexander Neumann, and Peter L. Biermann — Dept. of Phys., KIT, Karlsruhe, Germany

The so-called “GeV-excess” of the diffuse Galactic gamma-ray emission, is studied with a spectral template fit based on energy spectra for each relevant process of gamma-ray emission, which allows to determine simultaneously the standard background processes and possible new signals in each sky direction. The excess can be explained by the contribution of a new source with a spectrum peaking at 2 GeV. Three sources have been proposed in the literature: a dark matter annihilation signal (DM), a signal from milli-second pulsars (MSP) and a signal from molecular clouds (MC). All three sources have spectra peaking at 2 GeV, but slightly different spectral shapes and will be compared with the data. All hypotheses provide acceptable fits, if one considers a limited field-of-view around the Galactic center. However, if one considers the whole gamma-ray sky and includes gamma-ray spectra up to 500 GeV we find that the MC hypothesis is strongly preferred over the other hypotheses for several reasons: i) The MC hypothesis provides significantly better fits; ii) The morphology of the “GeV-excess” follows the morphology of the CO-maps, a tracer of MCs; iii) The massive central molecular zone shows the excess in its rectangular field-of-view which contradicts the spherical morphology expected for the other hypotheses.

T 77.4 Do 17:30 Philo-HS5

Search for Light Dark Matter with the MESA Accelerator — •Luca Doria — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz, Mainz (Germany)

At the Institute for Nuclear Physics of the Johannes Gutenberg University in Mainz, the construction of the new MESA facility has started. At its core there is a new superconducting energy-recovery linac which will provide intense electron beams for precision experiments in subnuclear physics. An important part of the MESA physics program consists in the search for a "dark sector" which is a candidate explanation for the long-standing dark matter puzzle. This talk will highlight the MESA dark sector program and in particular it will focus on the unique opportunity to install a beam-dump experiment for detecting dark matter particles in the MeV mass range. The experiment is in its design phase and the current status and future prospects will be presented.

T 77.5 Do 17:45 Philo-HS5

First results and status of the DEAP-3600 dark matter experiment — •Tina Pollmann[1] and Deap Collaboration[2] — [1]Technische Universität München — [2]SNOLAB, Sudbury, Kanada

DEAP-3600 is a single-phase liquid-argon Dark Matter direct detection experiment located 2 km underground at SNOLAB, in Sudbury, Canada. With a 1 tonne fiducial mass, the target sensitivity to spin-independent scattering of 100 GeV weakly interacting massive particles (WIMPs) is 10^{-46} cm^2. The detector was designed and built to reach a background level of less than 0.6 events in 3 tonne-years exposure. This included designing all parts of the detector to prevent or veto backgrounds, radio-purity screening for all detector materials, working with suppliers to source radio-pure materials, and using construction techniques that limit contaminations with radio-isotopes. The largest remaining background - beta decays from Ar-39 - is mitigated offline through pulse shape analysis. DEAP-3600 has been taking physics data since late 2016. This paper presents first results and the status of the experiment.

T 77.6 Do 18:00 Philo-HS5

Towards the next generation of Dark Matter searches: the h(bb) + E_T^{miss} signature in the 2HDM + pseudoscalar simplified model — •Lars Henkelmann and Oleg Brandt — Kirchhoff Institut für Physik, Heidelberg

A wide range of cosmological and astrophysical observations indicate the existence of Dark Matter. Yet, its particle properties are unknown. Constraining the particle properties of Dark Matter using collider experiments requires accurate and realistic model predictions. Such predictions cannot be obtained with Effective Field Theories because the mediators can be resolved at LHC energies for a large class of underlying theories.

The Two-Higgs-Doublet-Model with an additional pseudoscalar represents a simplified and ultraviolet-complete model for dark matter which provides a wide spectrum of experimental signatures with detectable cross-sections at the LHC. The sensitivity of the ATLAS experiment using the signature with a 125 GeV Higgs boson decaying to two b quarks and missing transverse momentum from dark matter particles is discussed in the context of this model. The exclusion potential is discussed using simplified detector-level limits. In addition, exact exclusion limits are provided based on the full analysis using 36.1 fb^{-1} of data.

T 77.7 Do 18:15 Philo-HS5

Improvement of Dark Matter searches with the ATLAS detector using dijet production to constrain systematic uncertainties — •Sebastian Mario Weber — Kirchhoff-Institut für Physik, Heidelberg, Deutschland

The composition and origin of Dark Matter (DM) remains one of the most important questions of modern physics and could be an avenue to phenomena beyond the Standard Model. A typical signature for direct DM production at hadron colliders is large missing transverse energy (E_T) in association with one or more energetic jets.

An irreducible background to this signature is the decay of the Z boson to neutrinos ($Z \to \nu\nu + jets$). For searches, a very precise control of this background in the signal region is necessary. This is typically achieved using a control region enriched with $Z \to l^+l^- + jets$ production. The main limitation of this approach is the small cross section of $Z \to l^+l^- + jets$ at large missing (E_T), resulting in statistical fluctuations that dominate the total uncertainty.

This talk proposes an improvement of DM searches with a new CR based on dijet production in the context of a cross section ratio measurement. The main advantage of this CR are small statistical uncertainties due to a higher cross section up to large missing E_T. The focus of this talk is the constraining power of the new CR with respect to

experimental jet systematics, as well as theoretical scale variations and uncertainties of the parton density functions.

T 77.8 Do 18:30 Philo-HS5

Hunting the Dark Higgs at CMS — •Samuel Baxter[1,2], Alexander Grohsjean[1], Christian Schwanenberger[1], and Oliver Buchmüller[2] — [1]Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany — [2]Imperial College London, London, England

The dark Higgs model is an extension of the Standard Model (SM) that describes the phenomenology of dark matter while respecting the SM gauge symmetries.
Besides adding a fermionic dark matter candidate to the SM, it introduces a new vector boson (Z') along with a new scalar, the dark Higgs particle.
This new approach provides several advantages over other so-called simplified models of dark matter which will be discussed in this talk. Moreover, a first search using 36fb^{-1} of proton-proton data recorded in 2016 by the CMS experiment, which is part of the LHC at CERN, will be presented.

T 77.9 Do 18:45 Philo-HS5

Neutrino-Dunkle Materie Interaktionen — •Tobias Pick, Gudrid Moortgat-Pick und Daniel Dercks — II. Institut für Theoretische Physik, Universität Hamburg

In dieser Bachelorarbeit wird die Interaktion von Neutrinos mit Dunkler Materie untersucht. Bei den hier angenommenen DM Kandidaten handelt es sich um Neutralinos, die supersymmetrischen Partner der elektrisch und farbneutralen Eich- und Higgsbosonen. Dabei werden verschiedene vom LHC erlaubte Parameter-Bereiche gescannt und die zugehörigen Wirkungsquerschnitte berechnet. Insbesondere wird untersucht, in wie fern die Wirkungsquerschnitte dieser Prozesse von der Temperatur abhängen.