T 28: Suche nach dunkler Materie II

Zeit: Dienstag 16:30–19:05 Raum: Philo-HS5

Gruppenbericht T 28.1 Di 16:30 Philo-HS5

Direkte Suche nach Dunkler Materie mit EDELWEISS: Resultate und Perspektiven — •Bernhard Siebenborn und Klaus Eitel — Karlsruher Institut für Technologie, Karlsruhe, Deutschland

Im EDELWEISS Experiment werden bei einer Temperatur von 18mK hochreine Germanium-Kristalle mit NTD-Phonon-Sensoren verwendet, um Kernrückstöße durch WIMPs zu detektieren. Diese können über das gleichzeitige Vermessen von Ionisations- und Phonon-Signalen identifiziert werden. In den laufenden Messungen wird das Phonon-Signal über den Neganov-Luke Effekt verstärkt, was die Suche nach low mass WIMPs im GeV-Bereich ermöglicht. Aktuelle Entwicklungen und Resultate werden vorgestellt und ein Experimentansatz mit neuen Phonon-Sensoren diskutiert, der die Sensitivität auch in den MeV Massenbereich erweitern wird.

T 28.2 Di 16:50 Philo-HS5

Studies of the XENON1T electronic recoil spectrum for physics beyond dark matter direct detection — •Christian Wittweg — Institut für Kernphysik, WWU Münster

XENON1T located at Laboratori Nazionali del Gran Sasso is the most sensitive dark matter direct detection experiment in the world today. It uses a dual phase time projection chamber with a sensitive liquid xenon volume of ~ 2 tons to detect weakly interacting massive particles (WIMPs). Its unprecedented low energy electronic recoil background of $(1.93 \pm 0.25) \cdot 10^{-4}$ events/(keV·kg·day) and the high target mass also make it sensitive to rare nuclear decays such as double beta decay processes as well as alternative dark matter candidates. Analyses in these physics channels require a detailed understanding of the electronic recoil spectrum from background sources.

This talk will focus on energy calibration, energy resolution and background modelling. A comparison of Monte Carlo simulations with the measured background energy spectrum will be presented. This work is supported by Deutsche Forschungsgemeinschaft (DFG) through the Research Training Group "GRK 2149: Strong and Weak Interactions - from Hadrons to Dark Matter".

T 28.3 Di 17:05 Philo-HS5

Solar axion search with a GridPix detector at CAST — •Sebastian Schmidt, Klaus Desch, Jochen Kaminski, and Tobias Schiffer — Physikalisches Institut, Universität Bonn

The CERN Axion Solar Telescope (CAST) is a helioscope experiment at CERN, searching for solar axions and chameleons. The inverse Primakoff effect is utilized to reconvert the particles into X-rays in the magnetic field of an LHC prototype dipole magnet.

A gaseous detector based on 7 GridPixes, a combination of a 256×256 pixel Timepix ASIC and an integrated MicroMegas stage on top, together with veto scintillators and an FADC, are utilized at CAST to provide an ultra low background detector.

The analysis framework, written in a combination of Nim and Python, will be discussed. The focus will be signal / background separation, using convolutional neural networks to maximize background suppression while retaining high signal efficiency.

Preliminary results of the 2017/18 data taking period will be presented.

T 28.4 Di 17:20 Philo-HS5

Deep learning techniques and field simulations for the DARWIN dark matter search — •Anna-Sophie Frick, Guido Drexlin, Ferenc Glück, and Daniel Hilk — Karlsruhe Institute of Technology, Karlsruhe

In the last years, dual phase noble gas detectors like XENON1T have been probing WIMP-nucleon cross sections down to 10^{-46} cm^2. The DARWIN (**DAR**k matter **WI**mp search with liquid xeno**N**) project aims to push the sensitivity to the ultimate limit for the spin-independent WIMP-nucleon cross section of $\mathcal{O}(10^{-49}\text{cm}^2)$ at the neutrino floor which will require a total mass of 50 tons of LXe.

As an experiment searching for rare events, DARWIN requires a good discrimination of all possible background sources from potential WIMP signals. To enhance the signal recognition, convolutional network methods which have successfully been applied to the KATRIN experiment have been transferred to the DARWIN detector to guide the layout of a LXe prototype to be built at KIT. This talk summarizes current results of the performance of deep learning techniques regarding different patterns.

Additionally, to further improve the understanding of signals and patterns, it is indispensable to simulate the electrostatic field with high precision within the DARWIN detector. This talk gives a brief overview of the current results of field simulations.

T 28.5 Di 17:35 Philo-HS5

FUNK: Search for Hidden Photon Dark Matter in Visible Range — •Christoph M. Schäfer[1], Arnaud Andrianavalomahefa[1], Kai Daumiller[1], Babette Döbrich[2], Ralph Engel[1], Joerg Jaeckel[3], Marek Kowalski[4,5], Axel Lindner[4], Hermann-Josef Mathes[1], Javier Redondo[6], Markus Roth[1], Thomas Schwetz-Mangold[1], Ralf Ulrich[1], and Darko Veberic[1] — [1]Institute for Nuclear Physics, Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany — [2]Physics Department, CERN, Geneva, Switzerland — [3]Institute for Theoretical Physics, Heidelberg University, Germany — [4]Deutsches Elektronen Synchrotron (DESY), Zeuthen, Germany — [5]Department of Physics, Humboldt University, Berlin, Germany — [6]Department of Theoretical Physics, University of Zaragoza, Spain

One possible candidate for the dark matter particles are hidden photons and, in case they exist and mix with ordinary tensor field, will be accompanied by a very small electric-field component, which on the surface of conducting materials converts into real photons. They are emitted nearly perpendicular to the surface and the frequency of the emitted real photons is matching the mass of the hidden photon. For this purpose a 14m^2 spherical metallic mirror was set up. By placing different detectors inside the radius point of the mirror, we are able to access various mass ranges of the hidden photon. We report on an experimental measurement completed using a low-noise photomultiplier tube, which is sensitive in the visible and near-UV part of the spectrum and thus covers the eV-range of possible hidden photon masses.

T 28.6 Di 17:50 Philo-HS5

Perspectives of Monojet searches on supersymmetric Dark Matter — •Conny Beskidt[1], Wim de Boer[1], and Dmitri Kazakov[1,2] — [1]Karlsruhe Institute of Technology (IETP) — [2]JINR, ITEP, Moscow, Russia

Roughly 85% of the matter in the Universe consists of dark matter made at least partially of weakly interacting massive particls (WIMPs). Supersymmetry (SUSY) can provide a perfect WIMP candidate: the Lightest Supersymmetric Particle (LSP), in many models the lightest neutralino, has all the required WIMP properties: it is neutral, massive, stable and weakly interacting. However, neutralinos are mixtures of gauginos and Higgsinos, so the LSP can become predominantly bino-, Higgsino- or singlino-like in the minimal and next-to minimal supersymmetric standard model. The impact of the current searches at the LHC for monojets on these supersymmetric models and their different scenarios is investigated.

T 28.7 Di 18:05 Philo-HS5

On the trail of dark matter by use of simplified models at CMS — Michael Dürr, Alexander Grohsjean, Kai Schmidt-Hoberg, Christan Schwanenberger, and •Nicole Stefanov — DESY, Hamburg, Germany

Various astrophysical observations could consistently be explained by the existence of dark matter. Assuming that it is a so-called weakly interacting massive particle, it could be produced and observed at the Large Hadron Collider.

In this talk, by use of simplified models, such a search for dark matter produced in association with a dileptonically decaying top quark pair will be covered focusing on the challenging kinematic reconstruction of the final state containing undetectable neutrino and dark matter pairs. The kinematic reconstruction is of particular interest since it enhances the detection capability of a potential signal and - in case of a discovery - it allows to study the nature of DM in great detail. Moreover, discovery prospects for extensions of the usual simplified models will be discussed.

T 28.8 Di 18:20 Philo-HS5

Search for Dark Matter produced in association with a W or

Z boson with the ATLAS Experiment at 13 TeV — •Stanislav Suchek and Oleg Brandt — Kirchhoff-Institut für Physik, Universität Heidelberg

Dark Matter composes a significant part of the visible Universe. Despite a solid cosmological evidence, its nature, properties and interaction with the Standard Model sector is still to be unraveled. Looking for the direct production of Dark Matter particles at particle colliders can shed light on the mystery of Dark Matter.
The signature of this search is a pair of quarks coming from the decays of the Standard Model W and Z bosons, recoiling against missing transverse momentum from Dark Matter particles. In addition to small-R jets, large-R jets are used to identify highly boosted W and Z bosons. The results using 36 fb^{-1} of 2015+2016 ATLAS pp collision data are presented. In case of no significant excess, limits on s-channel vector mediator models, as well as limits with reduced model dependence at 95% confidence level on the visible cross-section of W/Z + Dark Matter production, will be presented for different missing transverse energy regions.

T 28.9 Di 18:35 Philo-HS5

Optimierung der Suche nach dunklen Materie mit dem ATLAS-Detektor im Mono-V-Kanal — •Makoto Teshima, Philipp Gadow, Oliver Kortner, Sandra Kortner, Hubert Kroha und Patrick Rieck — MPI für Physik, München, Deutschland

Astrophysikalische und kosmologische Messungen zeigen die Existenz von nichtbaryonischer dunkler Materie im Universum. Teilchen der dunklen Materie könnten in Proton-Proton-Kollisionen am LHC entstehen. Wenn diese Teilchen zusammen mit einem Vektorboson erzeugt werden, kann man diese in Endzuständen mit großer fehlender Transversalenergie und zwei Jets aus dem Zerfall des Vektorboson finden. In dem Vortrag wird die Optimierung des Suche nach dunkler Materie in dieser Topologie besprochen. Besonderes Augenmerk wird hierbei auf die Wahl geeigneter Observabler wie etwa der fehlenden Transversalenergie und die Dijetmasse für die entgültige statistische Datenauswertung gelegt. Die erreichbare Empfindlichkeit bei der Suche nach dunkler Materie in Abhängigkeit der gewählten Observablen wird im Vortrag diskutiert.

T 28.10 Di 18:50 Philo-HS5

Suche nach Dunkler Materie in Ereignissen mit fehlender transversaler Energie und Jets beim ATLAS Experiment — •Andreas Reiss, Katharina Bierwagen und Volker Büscher — Johannes Gutenberg-Universität, Mainz, Deutschland

Astrophysikalische Beobachtungen legen die Existenz von Dunkler Materie im Universum nahe, deren Natur nicht genau bekannt ist. Durch die Datennahme mit dem Large Hadron Collider von 2015 bis 2017 bei einer Schwerpunktsenergie von 13 TeV werden neue Suchen nach Dunkler Materie in Proton-Proton-Kollisionen ermöglicht, die komplementär zu den indirekten und direkten Suchen sind.

Dieser Vortrag befasst sich mit der Suche nach Dunkler Materie und weiteren neuen Phänomenen in Ereignissen mit Abstrahlung von Jets im Anfangszustand und fehlender transversaler Energie. Dabei wird eine sehr genaue Untergrundabschätzung mit einer Genauigkeit von einigen Prozent benötigt. Hierbei ist es eine große Herausforderung, die datenbasierte Bestimmung der Untergründe und die Extrapolation in die Signalregion mit minimalen Theorieunsicherheiten durchzuführen. Als sensitive Variable wird hauptsächlich die fehlende transversale Energie verwendet in Kombination mit weiteren sensitiven Variablen. Ein Schwerpunkt wird hierbei auf Ergebnisse zu der Produktion von zwei Dunkle Materie Teilchen über Axial-Vektor- und Pseudo-Skalare-Mediatoren gelegt.