T 41: Search for Dark Matter II

Time: Tuesday 16:15–18:00 Location: VG 4.102

T 41.1 Tue 16:15 VG 4.102

Indirect Searches for Dark Matter with COSI — •Haoyu Xie[1,2], Savitri Gallego[1,2], Jan Lommler[1,2], and Uwe Oberlack[1,2] — [1]Johannes Gutenberg-Universität Mainz, Institut für Physik & ETAP - Experimentelle Teilchen- und Astroteilchen Physik — [2]On behalf of the COSI Collaboration

The NASA MeV mission COSI (Compton Spectrometer and Imager), to be launched in 2027, offers significantly improved sensitivity at high energy resolution and for diffuse emission due to a large field-of-view in the 0.2-5 MeV energy range. This energy range is particularly intriguing for indirect searches of dark matter, as sub-GeV DM candidates are still little constraint by direct searches, but could be detected indirectly as they either annihilate or decay into detectable gamma rays. In this work, we study the sensitivity of COSI to DM in the framework of a dark photon portal, exploring scenarios where sub-GeV dark matter annihilates into leptons, producing continuum gamma-ray signals. We also discuss opportunities to search for primordial black holes (PBHs) and sterile neutrino decays.

T 41.2 Tue 16:30 VG 4.102

The Status of the COSINUS Experiment — •Maximilian Hughes for the COSINUS-Collaboration — Max-Planck-Institut für Physik

COSINUS (Cryogenic Observatory for SIgnatures seen in Next generation Underground Searches) is a dark matter direct detection experiment using cryogenic sodium iodide (NaI) modules. The goal is a model independent test of the DAMA/LIBRA dark matter claim. Prototype modules using the remoTES to read out heat signals from NaI have been measured and the results will be presented. The underground facility construction is complete and the dry dilution refrigerator to provide the milli-kelvin temperatures required has been commissioned. The water Cherenkov muon veto surrounding the cryostat has been installed and filled with water. The next steps include installing cabling and superconducting quantum interference devices (SQUIDs) to read out the modules. The first data taking is planned to start in 2025 with eight 30 gram NaI modules.

T 41.3 Tue 16:45 VG 4.102

The first measurement of coherent elastic nucleus scattering of solar 8B neutrinos in the XENONnT experiment. — •Daniel Wenz for the XENON-Collaboration — University of Muenster

Liquid xenon (LXe) dual-phase time projection chambers (TPC) are thanks to their low energy threshold of sub-keV level and excellent background discrimination, the leading technology in the search for WIMP dark matter. They are also well suited to study other rare and faint phenomena like the coherent elastic neutrino-nucleus scattering (CEvNS) of solar neutrinos, opening a window towards solar and neutrino physics at lowest energies.

On of the leading experiment in this field is the XENONnT experiment, a highly sensitive, low background, dual-phase TPC with a LXe target volume of 5.9 t located at the Laboratori Nazionali del Gran Sasso (LNGS). In this talk the first measurement of solar ^{8}B neutrinos through CEvNS are presented by performing a dedicated low energy blind analysis, using an exposure of $3.51\,\mathrm{t}\cdot\mathrm{yr}$. The background only hypothesis was rejected with 2.73 sigma, resulting in a measured ^{8}B flux of $(4.7^{+3.6}_{-2.3})\cdot 10^{-6}\mathrm{cm}^{-2}\mathrm{s}^{-1}$. This result not only represents the very first measurement of CEvNS in LXe, but also CEvNS from solar neutrinos in general. It is therefore an important milestone towards a future liquid xenon observatory, not only for dark matter, but also for neutrino and solar physics.

This work is supported by BMBF ErUM-Pro 05A23PM1.

T 41.4 Tue 17:00 VG 4.102

Modeling the nuclear recoil response in XENONnT — •Johanna Jakob for the XENON-Collaboration — Institut für Kernphysik, Universität Münster

XENONnT, the latest stage of the XENON Dark Matter Project, is currently running with the science goals of detecting WIMP-nucleus scattering and searching for other rare events. The detector is a dual-phase time projection chamber filled with 5.9 tonnes of liquid xenon in the active volume. In the detector, neutral particles are most likely to interact with the nucleus, resulting in nuclear recoil (NR). Potential WIMP interactions as well as the rare Standard Model process of coherent elastic neutrino-nucleus scattering (CEνNS) both produce NR interactions. Consequently, characterizing the detector response to NR is essential for such investigations. Neutrons serve as an excellent calibration source for studying this response, as their NR interactions are indistinguishable from those of WIMPs or CEνNS. This talk discusses how neutrons tagged with coincident 4.4 MeV gammas from an ^{241}Am^{9}Be source are used to constrain the light and charge yield parameters of the NEST model (Noble Element Simulation Technique). This work is supported by BMBF ErUM-Pro 05A23PM1.

T 41.5 Tue 17:15 VG 4.102

Simulation and design optimization of the DARWIN observatory — •Antoine Chauvin, Maike Doerenkamp, and Stephanie Hansmann-Menzemer — Im Neuenheimer Feld 226, 69120 Heidelberg

The DARWIN observatory is a proposed future direct dark matter detection experiment. Its main science target is the detection of WIMP-like particles through WIMP-nucleus interactions, in a multi-ton liquid xenon TPC. Designing the experiment and optimizing its layout requires good modeling of the detection processes and the signal and background sources. In this talk, we report on the simulation of the detector responses to signal and background events in the DARWIN TPC. We present the sensitivity of the DARWIN baseline design to WIMP-nucleus scattering infered from these simulations and the impact of detector design choices on the DARWIN sensitivity.

T 41.6 Tue 17:30 VG 4.102

Electrode Design & Characterisation for the XLZD Observatory — •Alexey Elykov for the XLZD-Collaboration — Karlsruher Institut für Technologie, Institut für Astroteilchenphysik

The XLZD (XENON, LZ, DARWIN) collaboration aims to construct and operate the ultimate multi-tonne xenon-based direct detection astroparticle observatory. Hosting a time projection chamber (TPC) with more than 60 tonnes of liquid xenon, with a keV-range threshold and an ultra-low radioactive background it will aim to probe the entire parameter space for WIMP dark matter down to the so-called neutrino fog. XLZD scientific research program also includes searches for solar axions, axion-like particles, measurements of the solar neutrino flux and a probe of the Majorana nature of neutrinos.

High-voltage electrodes, spanning 3 m in diameter, will lie at the heart of the XLZD TPC, playing multiple key roles in signal generation and reconstruction. The electrodes need to be feasible to produce, mechanically robust, sufficiently transparent to light propagation and have minimal spurious electron and light emission from their surface.

An R&D program at KIT aims to tackle these challenges. We've developed several test setups aimed at studying emission from electrode samples and ways of mitigating it, as well as a high-voltage scanning system for electrodes. Here, we will present our recent work on electrode R&D towards XLZD-scale electrodes. This work is supported in part through the Helmholtz Initiative and Networking Fund (grant agreement no. W2/W3-118) and by BMBF (ErUM-Pro, grant no. 05A23VK3).

T 41.7 Tue 17:45 VG 4.102

Next-to-Leading-Order QCD Corrections to Dark Matter Annihilation into Wqq' in the CxSM — •Pavao Brica — Karlsruher Institut für Technologie, Karlsruhe, Deutschland

I will present the results for our computation of the next-to-leading-order QCD corrections to the annihilation process of two dark matter particles into a W boson, a massless quark and a massless antiquark. This process contributes to the computation of the dark matter relic density. The calculation has been performed within the framework of the complex singlet extension of the Standard Model which extends the Standard Model scalar sector by a complex singlet and yields an appropriate dark matter candidate. The treatment of the UV and IR divergences that arise in the calculation is briefly addressed. The cross section as well as the relic density are presented at next-to-leading order. The impact of these corrections is analyzed.