T 104: Search for Dark Matter V

Time: Friday 9:00–10:30 Location: VG 4.102

T 104.1 Fri 9:00 VG 4.102

A digital SiPM in liquid xenon — •Tiffany Luce[1], Michael Keller[2], and Peter Fischer[2] — [1]Physikalisches Institut, Universität Freiburg, 79104 Freiburg, Germany — [2]Institute for Computer Engineering, Heidelberg University, Germany

Silicon PhotoMultipliers (SiPMs) are photosensors commonly used in many experiments. However, achieving single-photon sensitivity in the experiments is limited by the high dark count rate (DCR) of these devices. Digital SiPMS, where the digitization happens directly on the chip, can show DCRs competitive to that of traditional photomultiplier tubes (PMTs) with the added benefit of not needing analog to digital converters and greatly reducing the data rate. This would open up to cheaper and thus larger systems. We present results of the first test of a digital SiPM in cryogenic liquid xenon, one of the most important detector target for dark matter searches.

T 104.2 Fri 9:15 VG 4.102

Development of assay techniques for the electrodes of a future xenon-filled dark matter obsevatory — •Alexander Deisting[1], Jan Lommler[1], Shumit Mitra[1], Uwe Oberlack[1,2], Fabian Piermaier[2], and Quirin Weitzel[2] — [1]Institut für Physik & Exzellenzcluster PRISMA$^+$, Johannes Gutenberg-Universität (JGU) Mainz — [2]PRISMA Detector Laboratory, JGU Mainz

Dual-phase xenon time projection chambers (TPCs) lead the search for WIMP dark matter. Current experiments (LZ, XENONnT, PandaX-4T) feature electrode diameters between 1 m and 1.5 m. The XLZD collaboration plans a next generation dual-phase TPC with 3 m height and diameter, representing an extraordinary scale for this technology.

Existing TPCs have struggled to achieve their design electric fields, making it ever more crucial for the XLZD TPC to ensure exceptional electrode quality. To address this challenge, a set-up has been developed in Mainz to evaluate electrode performance. It allows the measurement of electrostatic sagging, the analysis of wire quality with high resolution imaging and confocal microscopy, and the detection of small scale defects by measuring local currents associated with Townsend discharge in an electric field. For the latter, a custom tool was developed and mounted on a gantry together with other metrology components (camera, laser-distance sensors, and a confocal microscope). This talk benchmarks the sagging measurement capabilities and the performance of the discharge-based defect detection system. This work is part of ongoing efforts by XENONnT and DARWIN collaborators to develop improved electrodes for current and future experiments.

T 104.3 Fri 9:30 VG 4.102

Certification of 1.5m-TPC electrodes in a large liquid xenon R&D platform — •Julia Müller — University of Freiburg

Over the past decades dual-phase xenon time projection chambers (TPCs) for the direct search for dark matter continuously grew in size and became more sensitive. However, also the technical realization of these large TPCs got more and more challenging. Among the most crucial and also most complex detector components are the large-diameter TPC electrodes required to establish the electron drift field across the TPC. These electrodes need to feature a high optical transparency and high voltage resilience. The large-scale test platform PANCAKE in Freiburg allows testing such electrodes in a liquid xenon environment before they are installed into the final TPC. We will present results of a qualification campaign of three TPC electrodes of 1.5m diameter.

T 104.4 Fri 9:45 VG 4.102

RelExt: A new Tool to Search Dark Matter Relic Density Parameter Spaces — •Karim Elyaouti[1], Rodrigo Capucha[2], Johann Plotnikov[1], Milada Margarethe Mühlleitner[1], and Rui Santos[2] — [1]Karlsruher Institut für Technologie, ITP, Karlsruhe, Deutschland — [2]Centro de Física Teórica e Computacional, Lissabon, Portugal

We developed a tool which allows for efficient parameter space searches which obey the Dark Matter relic density constraint. Its goal is to find parameters for any model with a thermal Dark Matter candidate which is able to generate the full relic abundance observed by PLANCK. This is achieved by numerically solving the Boltzmann equation and providing different methods to automatically adjust the parameters such that the experimentally observed relic density is generated.

T 104.5 Fri 10:00 VG 4.102

In View of Large Detector Arrays: Automated Analysis Modules for COSINUS Direct Dark Matter Search — •Maximilian Gapp — Max Planck Institut für Physik, Garching, Deutschland

One unresolved issue is the explanation for the annual modulation in the rate of interactions in sodium iodide (NaI) crystals detected by DAMA/LIBRA, which is consistent with the expected dark matter signal. The COSINUS (Cryogenic Observatory for SIgnatures seen in Next generation Underground Searches) experiment has been designed to cross-check the long-standing results of the DAMA/LIBRA experiment. This will be achieved by employing cryogenic NaI calorimeters, which have low energy thresholds, and by introducing particle identification techniques through the use of an additional channel. In order to achieve this, it is necessary to test and characterize a significant number of detector prototypes. Furthermore, the COSINUS experiment plans to operate 16 channels initially and 48 subsequently. Given the substantial volume of data that will be generated, it is impractical to analyze the raw data manually. One solution is to automate the analysis chain wherever feasible. This contribution presents the analysis workflow for characterizing new prototypes and highlights potential avenues for automation.

T 104.6 Fri 10:15 VG 4.102

Characterization of a Spring-Based Passive Decoupling System with Capacitive Distance Measurements for the COSINUS Experiment — •Lutz Ziegele for the COSINUS-Collaboration — Max-Planck-Institut für Physik, 85748 Garching, Germany

The COSINUS experiment (Cryogenic Observatory for SIgnatures seen in Next generation Underground Searches) is a direct dark matter search, operating sodium iodide absorbers equipped with Transition Edge Sensors (TES) inside a dry dilution refrigerator. A spring-based passive decoupling system is used to reduce microphonics - one of the major non-particle background sources. To optimize the decoupling system, a profound understanding of its behavior is essential. However, a characterization of the decoupling system inside a closed cryostat at temperatures in the order of tens of milli-kelvin is not straightforward. This contribution discusses the capabilities and limitations of capacitive distance measurement sensors, which repurpose already existing refrigerator structures.