# T 81: Search for Dark Matter III

Time: Thursday 16:15–17:45 Location: AM 00.014

T 81.1 Thu 16:15 AM 00.014

**Study of few-electron backgrounds in the XENONnT detector** — •Sophie Armbruster — Max Planck Institut für Kernphysik, Heidelberg

When searching for light-mass dark matter with low-energy ionization signals down to the level of a single extracted electron using a dual-phase liquid xenon time projection chamber, it is crucial to understand and mitigate ionization backgrounds in the few-electron regime. Delayed single- and few-electron emissions are small charge signals that appear after a large charge signal but do not stem from independent low-energy interactions. Possible origins include photoionization processes, electron trapping by impurities,and temporary trapping of electrons at the liquid*gas interface. This talk presents a dedicated study of these delayed electron emissions using XENONnT data, focusing on their correlations with detector parameters. The results provide new insight into the phenomenology of few-electron backgrounds and support improved background modeling for future light dark matter searches with liquid xenon detectors.

T 81.2 Thu 16:30 AM 00.014

**Novel Purity Sensors in Liquid Xenon Time Projection Chambers** — •Tom Sonius — Karlsruhe Institute of Technology, Institute for Astroparticle Physics

The XLZD observatory will be a next-generation, multi-tonne xenon detector capable of probing dark matter and neutrino physics at unprecedented sensitivity. Its design features a dual-phase time projection chamber (TPC) containing 60 tonnes of liquid xenon (LXe).

Attaining the anticipated sensitivities requires extremely pure xenon so that rare event ionization signals are not degraded by their capture by electronegative impurities diffused in the liquid. Achieving this purity relies on advanced purification techniques, continuous recirculation, and dedicated purity monitoring systems.

Conventional LXe purity monitoring modules are bulky and must be placed outside the sensitive detector volume. A novel approach with minimal footprint and scalability is the use of carbon nanotube-based sensors that can be placed directly in the instrumented volume.

In this talk, I will present the current R&D efforts at KIT on the development of purity sensors based on single-layer carbon nanotubes, along with the status of their design and production, as a step towards novel purity sensing technologies for future LXe-TPCs.

This work is supported by the Impuls und Vernetzungsfonds of the Helmholtz Association (grant no. VH-NG-21-02).

T 81.3 Thu 16:45 AM 00.014

**Studies of dielectric breakdown in liquid xenon with the MOTION detector** — •Keyu Ding — Karlsruhe Institute of Technology, Institute for Astroparticle Physics

Next-generation liquid xenon (LXe) dark matter detectors are expected to double their linear dimensions compared to current-generation experiments. The future XLZD Observatory aims to build a detector with an inner diameter and height of nearly 3 m, hosting 60 tonnes of LXe in a time-projection chamber (TPC). The result, a tenfold increase in mass, enables dark matter searches approaching the neutrino fog, as well as rare-event searches such as neutrinoless double-beta decay and supernova neutrinos.

With the increased TPC height, the voltage delivered to the cathode exceeds previously tested ranges in LXe at this scale. Although LXe is predicted to sustain bulk fields near 1 MV/cm, experiments consistently observe dielectric breakdown at values much closer to the operating fields ($\mathcal{O}$(10–100) kV).

The MOTION detector, an ∼70 kg LXe setup at the Karlsruhe Institute of Technology, is used to study dielectric breakdown in LXe. We investigate how local field enhancement at electrode asperities and stressed electrode areas affect breakdown using various diagnostic methods. This work is supported by the Impuls und Vernetzungsfonds of the Helmholtz Association (grant no. VH-NG-21-02).

T 81.4 Thu 17:00 AM 00.014

**Optimization of Gold Collector Pads for remoTES Sensors on NaI Crystals in the COSINUS Experiment** — •Moritz Dörfler for the COSINUS-Collaboration — Max Planck Institute for Physics, Garching, Germany

Cryogenic calorimeters based on scintillating sodium iodide (NaI) crystals provide a promising approach for direct dark matter searches, as pursued by the COSINUS experiment (Cryogenic Observatory for SIgnatures seen in Next generation Underground Searches) at the Laboratori Nazionali del Gran Sasso (LNGS). In COSINUS detector modules, particle interactions in the absorber crystal are detected via phonon signals, which are read out by remote Transition Edge Sensors (remoTES). An efficient thermal coupling between the NaI crystal and the sensor is achieved by thin metallic collector pads deposited on the crystal surface and a wire bond connection. This contribution focuses on the development and characterization of gold collector pads used for phonon collection in COSINUS detector modules. The geometry, thickness, and deposition parameters of the gold films are critical for efficient phonon transport from the NaI crystal to the remoTES sensor, while maintaining sufficient mechanical stability and reproducibility. Optimizing the gold*NaI interface is an essential step toward improving the sensitivity and reliability of future COSINUS detector modules and contributes to the overall goal of achieving low-threshold, background-discriminating dark matter searches with NaI-based cryogenic detectors.

T 81.5 Thu 17:15 AM 00.014

**Results of a multi-wafer, double TES detector in the CRESST Experiment** — •Felix Dominsky for the CRESST-Collaboration — Max-Planck-Institut für Physik, Garching, Germany

CRESST (Cryogenic Rare Event Search with Superconducting Thermometers) is a leading direct-detection experiment for dark matter that implements Transition Edge Sensors (TESs) to measure minute energy depositions in cryogenic target crystals. As several other experiments in this field, CRESST observes an unexpected excess of events close to the detection threshold up to 200eV, commonly referred to as the low-energy excess (LEE). The current detector generation of CRESST employs two TES per crystal to better characterize this excess and investigate possible origins. Following this approach, CRESST has additionally deployed a stacked module, consisting of four vertically stacked, thin silicon on sapphire (SoS) wafer double-TES detectors. Their reduced target mass results in enhanced energy resolution, while the vertical arrangement allows the outer wafers to act as an active veto for the inner ones. This contribution will present the concept and motivation of this stacked-detector module and discuss first preliminary results and insights from its operation.

T 81.6 Thu 17:30 AM 00.014

**Low Energy Excess Studies in the CRESST Experiment** — •Judith Dohm for the CRESST-Collaboration — Eberhard-Karls-Universität Tübingen, 72076 Tübingen, Deutschland

The Cryogenic Rare Event Search with Superconducting Thermometers (CRESST) is a direct dark matter detection experiment located in the Laboratori Nazionali del Gran Sasso (LNGS) in Italy. CRESST operates cryogenic calorimeters equipped with Transition Edge Sensors (TES) operating in the millikelvin range. In the third phase (CRESST-III), energy thresholds of about 10eV have been reached, placing CRESST-III among the world-leading experiments in the search for sub-GeV dark matter. The experiment's sensitivity in the low mass region is currently limited by an unexplained rise of events below 200eV, the so-called low energy excess (LEE). The latest studies of the temporal behaviour and the energy spectrum of the LEE performed by CRESST will be presented in this talk.