T 11: Neutrinos, Dark Matter I

Time: Monday 16:30–18:00 Location: POT/0051

T 11.1 Mon 16:30 POT/0051

Status and Prospects of the COBRA experiment — •Juliane Volkmer — Technische Universität Dresden, Deutschland

As many Beyond-Standard-Model theories predict the existence of the neutrinoless double beta decay ($0\nu\beta\beta$), this lepton-number-violating nuclear reaction is one of today's most examined processes in fundamental physics. Its observation could help to solve important questions as for the neutrino's mass or whether it is a Majorana particle, and thus shed light on physics beyond the Standard Model.

In 2011 the COBRA demonstrator was built with the objective of investigating the practicability of using CdZnTe semiconductor crystals for the decay's investigation. The CdZnTe crystals contain nine isotopes capable of different $0\nu\beta\beta$ decay modes, can be operated at room temperature and are commercially available. Additionally, the versatile detector material offers the possibility of investigating physics besides the $0\nu\beta\beta$ decay, like a potential quenching of g_A in nuclear processes – by measuring the spectrum shape of the strongly forbidden ^{113}Cd β decay – and exotic $\beta^+\beta^+$ decay modes.

Four years ago the demonstrator setup of $4 \times 4 \times 4$ 1 cm^3 CdZnTe crystals was upgraded based on the knowledge gained from the many years of operation. With nine additional larger detector crystals higher exposure rates as well as strongly reduced background levels can be achieved.

This talk shall give an overview of the status, plans and most recent experimental results of the COBRA collaboration.

T 11.2 Mon 16:45 POT/0051

Pulse shape analysis with quad coplanar grid CdZnTe detectors of the COBRA experiment — •Yingjie Chu — Institute of Nuclear and Particle Physics, TU Dresden

The COBRA experiment searches for double beta decays using CdZnTe room temperature semiconductor detectors operating at the Gran Sasso underground laboratory. The setup was upgraded in 2018 using nine large CdZnTe detectors with the novel electrode layout, a quad coplanar grid surrounded by a guard ring, which can veto surface contaminations intrinsically. Although the prominent surface α backgrounds identified in the previous setup are reduced with the new CdZnTe detector, nonphysical events and other background events are present in the $\beta\beta$ region of interest. Therefore, pulse shape discriminations are evaluated to identify the noise, distorted pulses, and multi-hit events, which enables further background suppression. After applying those discrimination cuts, significantly reduced background levels are observed. Furthermore, the pulse shape of the detector is simulated and used to investigate the efficiency of the cuts.

T 11.3 Mon 17:00 POT/0051

Status of the MONUMENT Experiment; ordinary muon capture as a benchmark for $0\nu\beta\beta$ decay nuclear structure calculations — •Elizabeth Mondragon for the MONUMENT-Collaboration — Technical University of Munich, 85748 Garching, Germany

Extracting particle physics properties from neutrinoless double-beta ($0\nu\beta\beta$) decay requires a detailed understanding of the involved nuclear structures. Still, modern calculations of the corresponding nuclear matrix elements (NMEs) differ by factors 2-3. The high momentum transfer of Ordinary Muon Capture (OMC) provides insight into highly excited states similar to those that contribute virtually to $0\nu\beta\beta$ transitions. The precise study of the γ-radiation following the OMC process makes this a promising tool to validate NME calculations and test the quenching of the axial vector coupling g_A. The MONUMENT collaboration is performing a series of explorative OMC measurements involving typical $\beta\beta$ decay daughter isotopes such as ^{76}Se and ^{136}Ba, as well as other benchmark isotopes. The experiment carried out at the Paul Scherrer Institute and the first results from the beam-time in 2021 will be presented.

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T 11.4 Mon 17:15 POT/0051

COSINUS: Cryogenic Search for Dark Matter With Scintillating NaI Calorimeters — •Martin Stahlberg for the COSINUS-Collaboration — Max-Planck-Institut für Physik, Föhringer Ring 6, 80805 München

COSINUS (Cryogenic Observatory for SIgnatures seen in Next-generation Underground Searches) is a cryogenic dark matter direct detection experiment that aims for a model-independent cross-check of the DAMA/LIBRA claim for dark matter. Since 1995, the DAMA/LIBRA experiment is measuring a yearly modulated signal with properties that fit well to a local dark matter halo in the Milky Way. The DAMA/LIBRA target mass consists of 250 kg of sodium iodide, and the experiment reaches a significance of 13.7 sigma for its claim of a modulation. COSINUS detectors will read out both the scinitllation light signal and the heat signal caused by particle interactions. Each detector will consist of a NaI absober crystal equipped with a transition edge sensor using the remoTES design and a silicon beaker surrounding the absorber. With the dual-channel readout, which is unique for NaI , different types of interacting particles can be discriminated on an event-by-event basis. This contribution will present the status of the COSINUS experiment and its detectors.

T 11.5 Mon 17:30 POT/0051

Magnetic shielding tests for the COSINUS experiment — •Maximilian Hughes for the COSINUS-Collaboration — Max Planck Institute for Physics Föhringer Ring 6, 80805 München

The COSINUS experiment is a dark matter search using cryogenic detectors . The readout of these detectors is sensitive to environmental parameters such as magnetic fields. Active and passive shielding are being investigated to counteract the fluctuations of these fields. Superconducting materials enclosing the detectors and employed inside the dilution refrigerator can be used to keep magnetic field values constant after cooling. The operating conditions of the detectors with an applied magnetic field and a superconducting shield has been investigated. This talk will be a description of the efforts for the optimization of passive and active shielding for cryogenic detectors.

T 11.6 Mon 17:45 POT/0051

Vibration decoupling in the COSINUS underground facility — •Moritz Kellermann for the COSINUS-Collaboration — Max-Planck-Institut für Physik, Föhringer Ring 6, 80805 München

COSINUS is a direct dark matter detection experiment that will utilize cryogenic calorimeters based on sodium iodide (NaI) to resolve the tension between the positive dark matter signal measured by DAMA/LIBRA and the null-result by other experiments. Currently, a modern cryogenic facility is set up at the Laboratori Nazionali del Gran Sasso (LNGS) and is expected to begin operation within 2023. The facility includes a large clean room area on top of a 270 cubic meter water tank equipped with ~30 Photo Multiplier Tubes (PMTs) acting as an active muon veto. Detectors will be mounted in a custom-made dry dilution refrigerator with a base temperature of 9 mK. A lifting system will lower the refrigerator into a passive copper shielding within the water tank. To reach the thermal stability necessary for operating cryogenic calorimeters in a dry dilution refrigerator, a multi-stage passive vibration-decoupling system is currently being tested. This contribution will present the COSINUS facility and the planned vibration decoupling system.