T 15: Neutrinos, Dark Matter III

Time: Monday 16:30–18:00 Location: POT/0006

T 15.1 Mon 16:30 POT/0006

The SNO+ Experiment: Current Status and future Prospects — •Johann Dittmer and Kai Zuber — IKTP, TU Dresden, Deutschland

Located at 2 km underground in a mine near Sudbury, Ontario, Canada, the SNO+ experiment has an excellent shielding against cosmic rays. Due to this fact, it is nicely suitable for low background measurements. SNO+ consists of a 12 m diameter acrylic sphere filled with 780 t of a liquid scintillator. The sphere is observed by 9400 photomultipliertubes mounted on support structure with 18 m diameter. The main goal is to search for the neutrinoless double beta decay ($0\nu\beta\beta$) of ^{130}Te. For this, the scintillator will be doped with 3.9 t of natural Tellurium. Owing to it's design as a general purpose neutrino detector, it is also possible to measure neutrinos from different sources (geo, reactor, solar, Supernova, etc). After a commissioning water phase ended in 2019, a phase with pure scintillator started in 2022 is currently running. During this phase, reactor neutrino oscillations, low energy ^{8}B solar neutrinos and geo neutrinos are studied. In addition, background components of the $0\nu\beta\beta$ deacay are investigated. The double beta phase is forseen to run for 5 years starting in 2025.

In this talk, the recent results and the broad physics program will be presented.

SNO+ is funded by the German Research Foundation (DFG).

T 15.2 Mon 16:45 POT/0006

Improved detector response modelling for single-charge sensitive SuperCDMS detectors — •Matthew Wilson and Alexander Zaytsev for the SuperCDMS-Collaboration — Karlsruhe Institute of Technology, Institute for Astroparticle Physics

Recently, R&D facilities within the SuperCDMS collaboration have developed and employed cryogenic, high-voltage, eV-scale (HVeV) detectors with single-charge sensitivity. For a typical event observed by one of these gram-sized, silicon crystal detectors, the total amount of phonon energy measured is proportional to the number of electron-hole pairs created by the interaction. However, crystal imperfections and surface effects can cause propagating charges to either trap inside the crystal or ionize additional charges, producing non-quantized measured energy as a result. Modelling these detector-response effects continues to be important for the HVeV R&D program in order to understand calibration data and apply these effects on potential signals for dark matter searches. This presentation showcases an improved, more robust model of these detector-response effects that has fewer limitations and is capable of modelling more effects compared to previous models. This model allows for more accurate characterization of HVeV detectors and may facilitate discrimination between potential dark matter signals and background sources.

T 15.3 Mon 17:00 POT/0006

Low-frequency noise classification for the SuperCDMS experiment using Machine Learning — •Sukeerthi Dharani for the SuperCDMS-Collaboration — Karlsruhe Institute of Technology, Institute for Astroparticle Physics — University of Hamburg, Institute for Experimental Physics

The SuperCDMS Soudan experiment was a direct dark matter search experiment that was operated from 2012 to 2015 at the Soudan Underground Laboratory in Minnesota, USA. It used germanium crystal detectors at cryogenic temperatures to search for dark matter-nucleon scattering events. The experiment was affected by broadband low-frequency (LF) noise due to vibrations from the cryocooler, which deteriorated the detector baseline resolution and increased the noise trigger rate. The LF noise events can have a similar pulse shape as the low-energy signal events, making it difficult to remove them at low energies. In the final low ionization threshold analysis, this has led to stronger event selection criteria to remove LF noise events which set a higher analysis threshold and thus reduced the sensitivity of the experiment to low-mass dark matter. Currently, an LF noise selection criterion using machine learning is being studied. Under investigation is a convolutional neural network that yields better signal purity while also retaining signal efficiency. This talk discusses the machine learning-based classification of LF noise and its preliminary results.

T 15.4 Mon 17:15 POT/0006

The LEGEND Experiment - Status of commissioning and outlook — •Simon Sailer for the LEGEND-Collaboration — Max-Planck-Institut für Kernphysik, Heidelberg, Germany

The LEGEND experiment searches for the neutrino-less double beta ($0\nu\beta\beta$) decay of the germanium isotope 76Ge which would reveal the Majorana nature of neutrinos and prove lepton number non-conservation. The first stage of experiment (LEGEND-200) is built at the underground facility of LNGS in Italy. Here close to 200 kg of enriched high-purity germanium detectors ($\sim$88% 76Ge) are being deployed providing a discovery sensitivity for the half-life of the $0\nu\beta\beta$ decay of $> 10^{27}$ yr. within 5 years of measurement. The detectors are emerged in a liquid argon cryostat which simultaneously provides the coolant, a gamma-radiation shield and active veto system. The cryostat itself is surround by a large water tank acting as an additional neutron shield and muon-veto. LEGEND-200 is ending it's commissioning phase and switches to standard operations. Meanwhile the preparations for the second stage (LEGEND-1000) increasing the detector mass to 1 tonne are making great strides which will increase the sensitivity to $> 10^{28}$ yr. A non-observation would probe the effective Majorana neutrino mass $m_{\beta\beta}$ in the range of 10-20 meV and allow the exclusion of the inverted mass ordering.

T 15.5 Mon 17:30 POT/0006

Commissioning of the Liquid Argon Instrumentation of LEGEND-200 — •Rosanna Deckert, Patrick Krause, Laszlo Papp, Luigi Pertoldi, and Stefan Schönert — Technische Universität München

LEGEND (Large Enriched Germanium Experiment for Neutrinoless $\beta\beta$ Decay) is a ton-scale experiment to search for neutrinoless double beta ($0\nu\beta\beta$) decay using high-purity germanium detectors enriched in ^{76}Ge. An observation of $0\nu\beta\beta$ decay would prove the existence of lepton number violation and provide insight into the nature of neutrino masses. The first phase of the experiment LEGEND-200 will deploy 200 kg of enriched material and aims for a sensitivity of 10^{27} years on the $0\nu\beta\beta$ decay half-life. To achieve this, the germanium detectors are operated in liquid argon instrumented as an active detector to detect the scintillation light produced by backgrounds from trace radioactive contaminants. Commissioning of the liquid argon instrumentation, consisting of wavelength-shifting fibers, a wavelength-shifting reflector and silicon photomultipliers, took place during 2022 at the Laboratori Nazionali del Gran Sasso. In this talk, some of the main outcomes of the commissioning are presented.

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T 15.6 Mon 17:45 POT/0006

BSM physics searches beyond $0\nu\beta\beta$ decay with GERDA and LEGEND — •Elisabetta Bossio for the GERDA-Collaboration — Physik-Department E15, Technische Universität München, Garching, Germany

While searching for neutrinoless double-β ($0\nu\beta\beta$) decay, experiments collect huge statistics of the Standard Model (SM) two neutrino double-β ($2\nu\beta\beta$) decays. This is amongst the rarest nuclear processes ever observed. Beyond the Standard Model (BSM) physics, like the existence of new particles, Majorons, or light exotic fermions, or the violation of Lorentz symmetry, would affect the shape of the measured two-electron spectrum, originating detectable and characteristic signatures. The GERDA experiment, with its ultra-low background and excellent understanding of the experiment's response, set the best limits on the mentioned BSM double-β decays with ^{76}Ge [1]. In this contribution, the results of the GERDA experiment will be presented, and the sensitivity of the LEGEND experiment [2] to improve the current limits and to search for more exotic double-β decays involving non-standard interactions, like right-handed leptons currents or neutrino self-interactions, will be discussed. This research is supported by the BMBF through the Verbundforschung 05A20WO2 and by the DFG through the Excellence Cluster ORIGINS and the SFB1258.

[1] GERDA Collaboration, M. Agostini et al JCAP12(2022)012
[2] LEGEND-1000 pCDR, arXiv 2107.11462