HK 29: Astroparticle Physics II

Zeit: Dienstag 16:30–18:30 Raum: HS 18

Gruppenbericht HK 29.1 Di 16:30 HS 18

The Large Enriched Germanium Experiment for Neutrinoless double beta Decay - LEGEND — •Yoann Kermaidic for the LEGEND-Collaboration — Max Planck Institute für Kernphysik 1 Saupferchekweg 69117 Heidelberg

The search for neutrinoless double beta ($0\nu\beta\beta$) decay is a very sensitive probe of whether neutrinos are Dirac or Majorana particles. Its discovery could have far reaching consequences for particle physics and cosmology (leptogenesis). Current ^{76}Ge-based experiments, Gerda and Majorana Demonstrator, benefit from the best energy resolution and the lowest background in the signal region in the field if normalized by the resolution. These superior characteristics allow the ^{76}Ge program to reach a half-life sensitivity over 10^{26} yr in 2018, and demonstrates the feasibility of deploying a large-scale next-generation ^{76}Ge-based experiment. The Legend (Large Enriched Germanium Experiment for Neutrinoless $\beta\beta$ Decay) collaboration has been founded with the goal to build a ton-scale experiment and boost the $0\nu\beta\beta$ decay half-life sensitivity by two orders of magnitude. The collaboration pursues a phased approach, based on the Gerda and Majorana Demonstrator experience, starting in 2021 with 200 kg of ^{76}Ge. I will present the general aspect of Legend and focus on the ongoing developments for Legend-200, which will make use of the Gerda cryostat at the underground Laboratori Nazionali del Gran Sasso in Italy.

HK 29.2 Di 17:00 HS 18

Time correlated backgrounds in GERDA and LEGEND — •Mario Schwarz[1], Luciano Pandola[2], Stefan Schönert[1], and Christoph Wiesinger[1] for the LEGEND-Collaboration — [1]Physik-Department, Technische Universität München, Garching, Germany — [2]INFN Laboratori Nazionali del Sud, Catania, Italy

The Gerda (GERmanium Detector Array) experiment, located in the Laboratori Nazionali del Gran Sasso (LNGS), uses ^{76}Ge-enriched germanium detectors to search for the lepton number violating neutrinoless double beta ($0\nu\beta\beta$) decay. The detectors are operated in liquid argon (LAr) serving both as cooling medium and as active shield against radiation. Time correlated background events can lead to signals in the Ge-, LAr- and water Cherenkov detector systems, which in turn opens new ways for their identification and suppression. The in-situ production of $^{77(m)}$Ge by cosmic muon interactions is an example for a delayed coincidence, which will have an increasing influence on the next generation of experiments searching for the $0\nu\beta\beta$ decay of ^{76}Ge. This might define a minimum depth requirement for next generation rare event searches with Legend (Large Enriched Germanium Experiment for Neutrinoless $\beta\beta$ Decay). Therefore, mechanisms for identifying the cosmogenic $^{77(m)}$Ge production are proposed for the first stage of Legend at LNGS. The expected event topologies are presented as well as plans for an acquisition of the coincidences. This work has been supported in part by the German Federal Ministry for Education and Research (BMBF) Verbundforschung 05A17W02 and the German Research Foundation (DFG) via the SFB1258.

HK 29.3 Di 17:15 HS 18

Signal modeling in inverted coaxial HPGe detectors for Legend — •Tommaso Comellato, Matteo Agostini, and Stefan Schönert — Physik-Department, Technische Universität München, Garching, Germany

The Legend collaboration plans to operate in its first stage up to 200 kg of enriched High Purity Germanium (HPGe) detectors in the upgraded Gerda infrastructure at LNGS, Italy. The science goal is to search for the neutrinoless double beta decay of ^{76}Ge. In the current Gerda and Majorana Demonstrator experiments, enriched HPGe detectors with excellent pulse shape discrimination (PSD) properties are operated. Their masses are however typically below one kilogram. To reduce backgrounds from close-by parts as cables and holders, larger mass detectors without compromising the PSD performance are required. A novel detector geometry, referred to as inverted coaxial, is the baseline design of Legend HPGe detectors. A custom designed inverted coaxial detector with 1.6 kg mass was produced in collaboration with Baltic Scientific Instruments and the Helmholtz Research Center Rossendorf, and has been comprehensively characterized at TUM. In this talk I will present the latest results about the performance of this detector including the charge collection, signal shape properties and pulse shape discrimination performance. This work has been supported in part by the German Federal Ministry for Education and Research (BMBF) Verbundforschung 05A17W02 and the German Research Foundation (DFG) via the SFB1258.

HK 29.4 Di 17:30 HS 18

Characterization and Optimization of the Front-End Electronics for LEGEND — •Oskar Moras[1], Paul Barton[2], Konstantin Gusev[1,3], Patrick Krause[1], Antonio Lucchini[4], Alan Poon[2], Stefano Riboldi[4], Stefan Schönert[1], and Michael Willers[2] for the LEGEND-Collaboration — [1]Physik Department, Technische Universität München, Germany — [2]INPA and NSD, Lawrence Berkeley National Laboratory, Berkeley, California — [3]Joint Institute for Nuclear Research, Dubna, Russia — [4]Dipartimento di Fisica, Università degli Studi di Milano and INFN Milano, Italy

The LEGEND collaboration aims to use High-Purity Germanium (HPGe) detectors to search for neutrinoless double beta decay of ^{76}Ge. In order to achieve the projected sensitivity, an excellent spectroscopic performance is crucial, which is obtained by minimizing the electronic noise. Therefore, it is necessary to operate the first stage of the charge amplifier, a JFET and a feedback circuit, close to the detectors, which requires these components to be extremely radiopure. We report results from first integration tests carried out at TUM. This talk will cover optimization for noise and resolution performance in the test bench, as well as first results from measurements performed in a liquid argon cryostat with a HPGe detector. So far, a test pulser resolution of 0.5 keV @ 1 MeV (FWHM) was achieved. This work has been supported in part by the German Federal Ministry for Education and Research (BMBF) Verbundforschung and the German Research Foundation (DFG) via the SFB1258.

HK 29.5 Di 17:45 HS 18

Development of Low-mass Signal Readout Electronics for Legend-1000 — •Frank Edzards[1,2], Susanne Mertens[1,2], and Michael Willers[3] for the LEGEND-Collaboration — [1]Max-Planck-Institut für Physik — [2]Technische Universität München — [3]Lawrence Berkeley National Laboratory

Legend is a future ton-scale experiment to search for neutrinoless double beta decay ($0\nu\beta\beta$) in the isotope ^{76}Ge using high purity germanium detectors. Its observation would establish lepton number violation, provide information on the neutrino mass and open a window to understand matter dominance in our universe.

This talk focuses on the signal readout which is one of the most important components of a $0\nu\beta\beta$ experiment since it facilitates the conversion of charges produced within the detectors into appropriately shaped voltage signals. Current $0\nu\beta\beta$ experiments such as Gerda and Majorana Demonstrator use a readout solution consisting of several discrete electronic components. We are developing a highly integrated low-mass signal amplifier based on state-of-the-art *application specific integrated circuit* (ASIC) technology which allows us to combine all relevant components in a single low-mass chip. In the talk, we will focus on first results from characterization measurements of this signal readout.

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HK 29.6 Di 18:00 HS 18

Studying the impact of radon daughter removal techniques on xenon purity — Stefan Brünner, •Dominick Cichon, Guillaume Eurin, Florian Jörg, Teresa Marrodán Undagoitia, Natascha Rupp, and Hardy Simgen — Max-Planck-Institut für Kernphysik, Heidelberg, Germany

Liquid xenon (LXe) detectors play a key role in the search for new physics such as dark matter and the neutrinoless double-beta decay. For instance, XENON1T has been operating over the last years searching for dark matter interactions in its LXe time projection chamber (TPC). Although no direct evidence for particle dark matter has been found yet, the experiment set the, at the time of writing, strictest exclusion limits on the cross-section for interactions between dark matter particles and ordinary matter.

In order to increase the sensitivity of LXe detectors even further, as required by future experiments such as DARWIN, extensive R&D regarding background mitigation is needed. This is especially true when it comes to daughter nuclides of radon, which make up a major background contribution to new physics searches. This talk gives an overview about current activities linked to background reduction in LXe TPCs. The focus lies on investigating the impact of chemicals used to remove radon daughters from PTFE, a material commonly employed in LXe detectors, on the purity of xenon. For this purpose, an LXe TPC allowing for the rapid exchange of PTFE components has been built and commissioned. Results related to the detector performance as well as the subject of study are presented and discussed.

HK 29.7 Di 18:15 HS 18

Measurement of Rn-222 in water samples — •Judith Gafriller — Max-Planck-Institut für Kernphysik, Heidelberg

XENON1T is currently the most sensitive experiment for direct dark matter search. In order to reduce background events generated by radioactive decays or cosmic rays, the detector is surrounded by a water tank acting as a passive shield as well as an active Cherenkov veto system. For the upgrade XENONnT, the sensitivity will be further improved by enriching the water veto with Gadolinium. It will allow to capture and detect neutrons created within the detector materials. In order to check whether the trigger rate of the neutron veto system is sufficiently low a radon background study is necessary. For measuring radon in water a gas drying and purifying method was developed which supports the well established technique of sensitive radon measurements with proportional counters. In this talk the elaborated gas drying system and the results of the measurements will be discussed.