T 16: Neutrino Physics I

Time: Monday 16:45–18:15 Location: VG 3.103

T 16.1 Mon 16:45 VG 3.103

Recent advances in the search for $0\nu\beta\beta$ decay of 76Ge with LEGEND-200 — •Moritz Neuberger for the LEGEND-Collaboration — Physik-Department E15 Technische Universität München James-Franck-Straße D-85748 Garching Germany

The LEGEND collaboration's objective is to detect neutrinoless double-beta ($0\nu\beta\beta$) decay in ^{76}Ge using state-of-the-art enriched high-purity germanium (HPGe) detectors. In its first phase, LEGEND-200, the experiment has collected physics data for over a year, employing 140 kg of HPGe detectors in a liquid argon cryostat. This talk presents the results of the $0\nu\beta\beta$ decay analysis based on this data set. Furthermore, we will provide updates on integrating additional HPGe detectors and discuss auxiliary studies used to develop our background model further.

This research is supported by the DFG through the Excellence Cluster ORIGINS EXC 2094 - 390783311, the SFB1258, and by the BMBF Verbundprojekt 05A2023.

T 16.2 Mon 17:00 VG 3.103

Muon Veto of LEGEND-200: Analysis and Simulations — •Gina Grünauer — Physikalisches Institut, Eberhard Karls Universität Tübingen

The **L**arge **E**nriched **G**ermanium **E**xperiment for **N**eutrinoless $\beta\beta$ **D**ecay (LEGEND) is an phased experimental program dedicated to the search for neutrinoless double beta ($0\nu\beta\beta$) decay of ^{76}Ge. To reach the aimed discovery sensitivity for a half-life of more than 10^{28} years, a background rate of less than 10^{-5} cts/(keV·kg·yr) is required. A Water-Cherenkov-Veto operates for this purpose for the current experimental phase LEGEND-200. It uses photomultiplier tubes (PMTs) as light detectors in a water-tank lined with a reflective foil to increase the light yield within the system. This contribution provides the working principle as well as the ongoing data analysis and simulations of the Muon Veto of LEGEND-200.

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T 16.3 Mon 17:15 VG 3.103

Search for Neutrinoless Double Beta Plus Decays with NuDoubt^{++} — •Cloé Girard-Carillo for the NuDoubt-Collaboration — Johannes Gutenberg-Universität Mainz

The discovery of neutrino oscillations revealed the possibility of neutrinos having masses, which could originate from Majorana particles and result in lepton number violation. One way to observe this violation is through neutrinoless double beta decay, where neutrinos are exchanged internally without appearing as external particles.

Most experiments so far have focused on double electron emission. However, advancements in new scintillator technologies, offering enhanced particle identification, now make it feasible to investigate double positron emission processes as well.

This presentation introduces the NuDoubt++ experiment, which uses a hybrid opaque scintillator with isotope loading to search for such a process. This combination makes it possible to separate signal from background using event topology and the ratio of Cherenkov to scintillation light. We will also explain how we plan to load $\beta\beta$ isotopes into the scintillator and describe a new proposal for collecting light more efficiently. We present the latest progress on the project, including recent developments in detector design and performance.

T 16.4 Mon 17:30 VG 3.103

Event Classification for the Hybrid Opaque Scintillator Experiment NuDoubt^{++} — •Kyra Mossel for the NuDoubt-Collaboration — Johannes Gutenberg-Universität Mainz, Institut für Physik, 55128 Mainz, Germany

Neutrinoless double beta decay is a hypothetical nuclear process assuming that could occur if the neutrino is its own antiparticle. In this process, two neutrons (protons) decay into two protons (neutrons), emitting two electrons (positrons) but no neutrinos, thereby violating lepton number conservation and demonstrating the Majorana nature of the neutrino. Detecting this extremely rare decay requires exceptionally low background levels and reliable particle identification mechanisms.

The NuDoubt^{++} experiment, designed to study double beta plus decays, addresses this challenge using a novel hybrid and opaque scintillator which is permeated by a fine grid of optical fibers. This setup utilizes both the topology of energy deposits and the ratio of Cherenkov to scintillation light to enhance background discrimination and particle identification.

This presentation focuses on the Cherenkov-to-scintillation light ratio as a tool for background discrimination. The expected photon arrival time distributions for different background event types are shown as well as the experiment's anticipated performance to distinguish them from signal events.

T 16.5 Mon 17:45 VG 3.103

Studies on general neutrino interactions with the KATRIN experiment — •Hanna Henke and Caroline Fengler for the KATRIN-Collaboration — Institute for Astroparticle Physics, Karlsruhe Institute of Technology, Karlsruhe, Germany

The KATRIN Experiment aims to determine the neutrino mass using precision spectroscopy of electrons from tritium β-decay. Recently, KATRIN published an improved upper bound of 0.45 eV at 90% C.L. [1] on the effective electron-neutrino mass; the latest step in an ongoing effort to reach a target sensitivity of below 0.3 eV. Supplementary to the neutrino mass measurement the high-precision spectroscopy allows to probe beyond standard model physics, for instance general neutrino interactions (GNI), which can be examined through shape deformations in the integral β-energy spectrum. For the GNI a model-independent approach combines each theoretically allowed interaction term into one effective field theory to describe the impact of energy-dependent spectrum contributions as an indicator for novel weak processes. Recently, first constraints on general neutrino interactions based on KATRIN data were released [2]. This talk will give an overview of the GNI framework and analysis, and present further GNI studies.

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[1] arXiv:2406.13516, [2] arXiv:2410.13895

T 16.6 Mon 18:00 VG 3.103

Adiabatic characteristics of the KATRIN beamline in the TRISTAN phase — •Justus Beisenkötter for the KATRIN-Collaboration — Intitut für Kernphysik, Universität Münster

After the end of the neutrino mass search with KATRIN, the current focal plane detector will be replaced by the new TRISTAN detector with significantly better energy resolution and higher granularity, to enable a search deep into the tritium beta-decay spectrum for keV sterile neutrinos. In this new measurement phase, the retarding potential of the KATRIN main spectrometer will be reduced from the current level near the spectral end point to a few kV. This will lead to much higher surplus energies in the spectrometer, so that the magnetic moment $\mu = E_\perp/B$ of the beta electrons is no longer constant and the adiabatic approximation for electron tranport is no longer valid. Simulations have shown that by changing the field configuration, moving the highest magnetic field from the detector side of the main spectrometer to the source side, the non-adiabatic effects can be suppressed. The talk will present the results of measurements of this new magnetic field setup and a comparison with simulation results. This work is supported by BMBF ErUM-Pro 05A23PMA.