# T 86: Neutrino physics 10

Time: Thursday 16:00–18:00 Location: Geb. 30.21: Gerthsen-HS

T 86.1 Thu 16:00 Geb. 30.21: Gerthsen-HS

**Sensitivity Studies on the Implementation of New Detector and Source Concepts at KATRIN** — •Svenja Heyns for the KATRIN-Collaboration — KIT, IAP

The Karlsruhe Tritium Neutrino experiment (KATRIN) is leading the direct kinematic neutrino mass measurement with an upper limit on the effective neutrino mass $m_\nu$ of $0.8\,\mathrm{eV/c^2}$ (90% CL) based on the initial two measurement campaigns, and a final sensitivity of below $0.3\,\mathrm{eV/c^2}$.

Making further steps towards an ultimate sensitivity to the neutrino mass below the level of $0.1\,\mathrm{eV/c^2}$ may require significant conceptual modifications in the future neutrino mass determination with KATRIN. In this talk we present sensitivity studies on the impact of a high-resolution electron detector for a neutrino mass measurement which implies the measurement of a differential electron spectrum in comparison to the present integral measurement. The use of atomic tritium is explored as a replacement for the current molecular source to avoid the limitation posed by molecular final states. The results presented in this talk show that with these modifications a KATRIN-like experiment can potentially reach the inverted hierarchy, and indicate what is necessary to increase even further in sensitivity.

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T 86.2 Thu 16:15 Geb. 30.21: Gerthsen-HS

**ELECTRON - Development of High Resolution Metallic Microcalorimeters for a Future Neutrino Mass Experiment** — •Neven Kovac[1], Fabienne Bauer[2], Tamara App[1], Beate Bornschein[1], Daniel de Vincenz[1], Ferench Glück[1], Svenja Heyns[1], Sebastian Kempf[2], Marie-Christin Langer[2], Michael Müller[2], Rudolf Sack[1], Magnus Schlösser[1], Markus Steidl[1], and Kathrin Valerius[1] — [1]Institute for Astroparticle Physics (IAP), Karlsruhe Institute of Technology — [2]Institute of Micro- and Nanoelectronic Systems (IMS), Karlsruhe Institute of Technology

Metallic Magnetic Calorimeters (MMCs) are low temperature single particle detectors, whose working principle is based on quantum technology. Due to their excellent energy resolution, near linear detector response, fast signal rise time and close to 100% quantum efficiency, MMCs outperform conventional detectors by several orders of magnitude, making them interesting for a wide range of different applications. The aim of the ELECTRON project is to demonstrate, for the first time, that MMC based detectors can be employed for a high resolution spectroscopy of external electron sources, namely electron-gun, krypton-83m and tritium. Technology and methods developed within the context of the ELECTRON project will pave a way for the next generation neutrino experiments with tritium, employing a differential detector based on quantum technology. We present the first measurements of the $^{83m}$Kr spectrum performed with an MMC-based detector, as well as the efforts put towards the first ever measurements of the tritium $\beta$-decay spectrum using a novel compact tritium source.

T 86.3 Thu 16:30 Geb. 30.21: Gerthsen-HS

**KATRIN like MINI MAC-E Filter with a tritium source for the advanced physics lab course** — •Sarah Untereiner for the KATRIN-Collaboration — Karlsruhe Institute of Technology (KIT), Wolfgang-Gaede-Str. 1, 76131 Karlsruhe, Germany

The KATRIN experiment aims to determine the effective neutrino mass using the kinematics of electrons from the tritium $\beta$-decay. The integral energy spectrum of the electrons is measured by an electrostatic high-pass filter, using the MAC-E filter principle (Magnetic Adiabatic Collimation and Electrostatic filter). Only electrons with energies above the retarding potential of the filter are counted at the detector at the end of the MAC-E spectrometer. In order to give students the opportunity to learn more about the experimental principles behind KATRIN, a smaller version of the MAC-E filter setup, called MiniMACE, has been built, which will be used in the advanced physics lab course at KIT. With a scale of approximately 1:20 the MiniMACE experiment includes all the major components of KATRIN: a tritium source, the spectrometer with adjustable high voltage, a high resolution detector and the magnetic guiding field. Other than KATRIN, the source uses two implanted disks with tritium and $^{83m}Kr$ that can be exchanged inside the ultra-high vacuum source chamber. This talk is about the design of the physics lab setup and reports on first results. This project has been supported by RIRO (Research Infrastructure in Research-Oriented teaching), which is part of the ExU project at KIT.

T 86.4 Thu 16:45 Geb. 30.21: Gerthsen-HS

**LEGEND-200 Calibration Performance with the LEGEND Julia Software Stack** — •Florian Henkes[1], Oliver Schulz[2], and Felix Hagemann[2] for the LEGEND-Collaboration — [1]Physik-Department, Technische Universität München, Germany — [2]Max-Planck Institut für Physik, Garching, Germany

The **L**arge **E**nriched **G**ermanium **E**xperiment for **N**eutrinoless $\beta\beta$ **D**ecay (LEGEND) is a ton-scale, $^{76}$Ge-based, neutrinoless double-beta ($0\nu\beta\beta$) decay experimental program with discovery potential at half-lifes greater than $10^{28}$ years. The first 200 kg stage of the experiment, LEGEND-200, is currently taking data at Gran Sasso underground laboratory in Italy. We present the first analysis results on LEGEND-200 calibration data gained using the LEGEND Julia Software Stack. We will focus specifically on the performance of the energy reconstruction and pulse-shape discrimination algorithms. We acknowledge support by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) under Germany*s Excellence Strategy * EXC 2094 * 390783311, the support by the BMBF Verbundprojekt 05A2023 - LEGEND: Suche nach dem neutrinolosen doppelten Beta-Zerfall in Ge-76 mit LEGEND and the Max-Planck Society.

T 86.5 Thu 17:00 Geb. 30.21: Gerthsen-HS

**Towards a Better Liquid Argon Anti-Coincidence Classifier for LEGEND-200** — Elisabetta Bossio[2], •Rosanna Deckert[1], Nils Doll[1], Patrick Krause[1], Luigi Pertoldi[1], Stefan Schönert[1], and Mario Schwarz[1] for the LEGEND-Collaboration — [1]Technical University of Munich, Garching, Germany — [2]IRFU, CEA, Université Paris-Saclay, Paris, France

LEGEND-200 is an experiment designed to search for neutrinoless double beta decay of Ge-76. Located deep underground at LNGS, it operates up to 200 kg of enriched high-purity germanium (Ge) detectors in a liquid argon (LAr) cryostat. To achieve ultra-low backgrounds, the LAr is instrumented as an active detector to detect scintillation light emitted upon interactions with ionizing radiation, thus tagging and rejecting backgrounds. The current rejection condition of the LAr anti-coincidence cut uses the LAr detector's light intensity information. In this talk, we will present a test statistic-based approach that exploits the time information of the LAr signals relative to the Ge signals. This new classifier can be used in a multivariate analysis to exploit the full potential of the LAr instrumentation's rejection power.

This research is supported by the BMBF through the Verbundforschung 05A20WO2 and by the DFG through the Excellence Cluster ORIGINS and the SFB1258.

T 86.6 Thu 17:15 Geb. 30.21: Gerthsen-HS

**The LEGEND Experiment DAQ** — •Simon Sailer for the LEGEND-Collaboration — Max-Planck-Institut für Kernphysik, Heidelberg, Germany

The LEGEND experiment searches for the neutrino-less double 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 and is successfully taking data since beginning of 2023.

The DAQ hardware is based on the FlashCam readout system and operating at two sampling frequencies: 250/62.5 MSamples/s with 12/16-bit dynamic range respectively. The individual digitizer boards perform continous fully-digital trigger formation and are interconnected with a hierarchical clock- and trigger distribution system. In addition, the development for a 2nd stage software trigger is finished, enabling real-time reconstruction of the detected photo-electrons from the liquid Argon active veto and >millisecond time-windows on coincidence requirements.

For LEGEND-1000, R&D is ongoing for a possible upgrade of the system using new generations of FPGAs providing higher sampling

frequencies with a higher on-board channel density.

T 86.7 Thu 17:30 Geb. 30.21: Gerthsen-HS

**Design of a Drift Tube Spectrometer for AdvSND@LHC** — •Wei-Chieh Lee, Daniel Bick, and Caren Hagner — Institut für Experimentalphysik, Universität Hamburg

The Advanced Scattering and Neutrino Detector at the Large Hadron Collider (AdvSND@LHC) is proposed as a possible upgrade to the existing SND@LHC. In the design of this upgraded detector, stations of trackers are included to measure the charge and momentum of muons emerging from neutrino interactions in the target with a required track resolution better than 100 $\mu$m.

A first design of drift tube trackers has been developed for this purpose at the Universität Hamburg, and prototyping is currently ongoing. In this talk, the foreseen setup will be presented, including the mechanical design as well es the front end electronics. First measurements with a test tube and plans for a larger prototype module will be shown.

T 86.8 Thu 17:45 Geb. 30.21: Gerthsen-HS

**North Area Neutrino Experiment at SPS collider CERN** — Chen Wang, •Dhruv Chouhan, Matthias Schott, and Rainer Wanke — Johannes Gutenberg University, Mainz, Germany

The North Area Neutrino is a new beam-bump experiment proposed to study the neutrino sector of the Standard Model in the energy realm of 10GeV - 60GeV. The main goal of NaNu is a first discovery of anti-tau neutrinos.