T 82: Neutrino physics 9

Time: Thursday 16:00–18:00 Location: Geb. 20.30: 2.058

T 82.1 Thu 16:00 Geb. 20.30: 2.058

Final CEvNS result of the CONUS experiment at the Brokdorf reactor — •Nicola Ackermann for the CONUS-Collaboration — Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg

The CONUS experiment (COherent elastic NeUtrino nucleus Scattering) aimed to detect coherent elastic neutrino-nucleus scattering (CEvNS) of reactor antineutrinos on germanium nuclei by measuring their recoil after such an interaction. It operated from 2017 to 2022 at 17m distance from the 3.9 GWth core of the Brokdorf nuclear power plant (Germany). The experiment employed four 1 kg point-contact high-purity germanium (HPGe) detectors, which provided an energy threshold of 210 eV and background rates in the order of 10 events per kg, day and keV.

The analysis of the final CONUS data set allows to establish the current best limit on CEvNS from a nuclear reactor with a germanium target, improving the previous CONUS result by an order of magnitude. Moreover, this new result refutes other measurements where quenching factors deviating significantly from Lindhard theory were considered. The results from the last physics run together with the quenching measurements performed by CONUS will be discussed in this talk.

T 82.2 Thu 16:15 Geb. 20.30: 2.058

CEνNS **at reactor site with CONUS+** — •Janine Hempfling, Nicola Ackermann, Sophie Armbruster, Aurelie Bonhomme, Hannes Bonet, Christian Buck, Janina Hakenmueller, Gerd Heusser, Manfred Lindner, Werner Maneschg, Kaixiang Ni, Thomas Rink, Edgar Sanchez-Garcia, and Herbert Strecker for the CONUS-Collaboration — Max-Planck Institut fuer Kernphysik, Heidelberg, Germany

As a successor of the CONUS (COherent elastic NeUtrino nucleus Scattering) experiment CONUS+ aims for the detection of coherent elastic neutrino nucleus scattering with antineutrinos on a germanium target at a nuclear reactor. After the shut down of the Brokdorf nuclear reactor in 2021 the upgraded CONUS setup was moved successfully to a new site, the nuclear power plant in Leibstadt (Switzerland). CONUS+ is located at 21m distance from the 3.6 $\mathrm{GW_{th}}$ reactor core and is equipped with the four former 1kg point-contact high-purity germanium detectors of CONUS which were optimized to achieve a significantly improved performance. Additionally, a second active muon-veto system is installed to improve the tagging of cosmogenic background. This talk will focus on the background characterization campaign at the new reactor site, the improvements of the detectors and the whole setup, the final installation and the first data-taking run of CONUS+.

T 82.3 Thu 16:30 Geb. 20.30: 2.058

Simulation of CLOUD, the first LiquidO reactor antineutrino experiment — •Cloé Girard-Carillo for the CLOUD-Collaboration — Johannes Gutenberg University, Mainz, Germany

LiquidO is an innovative particle detection paradigm using opaque liquid scintillators. The emitted light is confined near its creation point and captured by a lattice of wavelength-shifting fibers. This enables high-resolution imaging for particle identification down to the MeV scale, giving LiquidO the potential for various practical applications in particle physics.

After the successful development of two prototypes and with a third currently under construction, the next step is to build a 5 to 10-ton detector at the ultra-near site of the Chooz nuclear power plant in France. This is part of an Innovation program (EIC-Pathfinder project - AntiMatter-OTech) for monitoring nuclear reactor activity. The CLOUD collaboration, composed of 18 institutions over 11 countries, plans to exploit the fundamental science programme associated to this project.

Constructing the detector at the ultra-near site poses challenges, as being at the surface implies a high cosmic background rate. It also imposes strict constraints on design elements such as materials and maximum building size. The external background simulations presented in this talk are essential for guiding the detector design, taking into account these challenges. They play a crucial role in understanding the capabilities of a LiquidO-based detector operated at a nuclear power plant.

T 82.4 Thu 16:45 Geb. 20.30: 2.058

Reconstruction of atmospheric neutrino events for NMO analysis in JUNO using GCNs — •Rosmarie Wirth, Caren Hagner, Daniel Bick, and Vidhya Thara Hariharan — Universitaet Hamburg, Hamburg, Germany

The Jiangmen Underground Neutrino Observatory (JUNO) is a large liquid scintillation detector, currently under construction in Jiangmen, China. With its 20 kt volume, high energy resolution of $3\,\%/\sqrt{E[MeV]}$ and great optical coverage of 78 %, JUNO is aiming to unveil the Neutrino Mass Ordering (NMO) with a $3\,\sigma$ significance within 6 years of data taking, by observing reactor electron anti-neutrinos.
Additionally, JUNO will be sensitive to atmospheric neutrinos in lower energy ranges than today's Cherenkov detectors. Upward-going atmospheric neutrinos in the low GeV energy range show a different oscillation pattern for the normal and inverse ordering hypothesis, due to experiencing the matter effect when passing earth's core. Thereby, they could contribute to JUNOs NMO analysis as an independent secondary channel. To do so, the atmospheric neutrino events need to be reconstructed precisely.
This talk shows methods to reconstruct low GeV atmospheric neutrino events in JUNO using Graph Convolutional Networks (GCNs).

T 82.5 Thu 17:00 Geb. 20.30: 2.058

EoS: A Pathfinder Experiment for Low Energy Neutrino Physics with the Hybrid Detector THEIA — •Hans Theodor Josef Steiger — Physik-Department, Technische Universität München, James-Franck-Str. 1, 85748 Garching, Germany — Johannes Gutenberg University Mainz, Cluster of Excellence PRISMA+, Staudingerweg 9, 55128 Mainz, Germany

Future ktonne-scale, scintillation-based neutrino detectors, such as THEIA, plan to exploit new and yet to be developed technologies to simultaneously measure Cherenkov and scintillation signals in order to provide a rich and broad physics program. These hybrid detectors will be based on fast timing photodetectors, novel target materials, such as water-based liquid scintillator (WbLS), and spectral sorting. Besides a brief overview on THEIA*s program for low energy astroparticle and particle physics this talk focuses on a currently realized demonstrator experiment, called EOS. This novel detector with an approximately 4-tonne target fiducial volume is under construction at the UC Berkeley and LBNL (Lawrence Berkeley National Laboratory). The detector will provide a test bed for these emerging technologies required for hybrid Cherenkov/Scintillation detectors. Furthermore, EOS will deploy calibration sources to verify the optical models of WbLS and other liquid scintillators with slow light emission, to enable an extrapolation to ktonne-scale detectors. After achieving these goals, EOS can be moved near a nuclear reactor or in a particle test-beam to demonstrate neutrino event reconstruction or detailed event characterization within these novel detectors.

T 82.6 Thu 17:15 Geb. 20.30: 2.058

Observables of the Electrical Potential of the KATRIN Tritium Source from Calibration with a High-Intensity Krypton-83m Source — •Moritz Machatschek — Institute for Astroparticle Physics, Karlsruhe Institute of Technology

The KArlsruhe TRItium Neutrino experiment currently provides the best neutrino-mass upper limit of 0.8 eV/c^2 (90 % C.L.) in the field of direct neutrino-mass measurements. After a total measurement time of 1000 days in 2025, a final sensitivity better than 0.3 eV/c^2 (90 % C.L.) is expected, which at the same time requires a detailed study of systematic measurement uncertainties.

One major uncertainty is linked to the electric potential inside the tritium source. Inhomogeneities of the potential lead to a distortion of the β-spectrum, which needs to be characterized in order to reduce the systematic bias in the neutrino-mass measurement.

To this end we use conversion electrons from $^{83\mathrm{m}}$Kr as nuclear standard. Traces of gaseous $^{83\mathrm{m}}$Kr are circulated alongside tritium in the 10 m long source, such that inhomogeneities of the potential are observable as a broadening of the selected mono-energetic $^{83\mathrm{m}}$Kr lines. In this talk we describe the results of $^{83\mathrm{m}}$Kr campaigns carried out in 2021 and 2023 and their impact on the neutrino-mass determination.

This work is supported by the Helmholtz Association and by the Ministry for Education and Research BMBF (grant numbers 05A23PMA, *05A23PX2, 05A23VK2, and 05A23WO6).*

T 82.7 Thu 17:30 Geb. 20.30: 2.058

First glance at the latest science runs of the KATRIN neutrino mass experiment using the KaFit analysis package — •Richard Salomon[1] and Jaroslav Storek[2] for the KATRIN-Collaboration — [1]Institute for Nuclear Physics, University of Münster — [2]Institute for Astroparticle Physics, Karlsruhe Institute of Technology

Performing a precision measurement of the endpoint region of the tritium β-decay spectrum, the Karlsruhe Tritium Neutrino (KATRIN) experiment aims at measuring the neutrino mass with a sensitivity of better than $0.3\,\mathrm{eV/c^2}$ (90% C.L.). The current world-leading upper limit of $m_\nu \leq 0.8\,\mathrm{eV/c^2}$ (90% C.L.) was determined from combined analysis of the first two measurement campaigns and a publication including the three subsequent measurement campaigns is currently in preparation.

The focus of this presentation is on the most recent measurement phases, which feature a significant increase of statistics in the region of interest. Following KATRIN's model blinding strategy, studies on Asimov data using the *KaFit/SSC* model within the *Kasper* framework will be presented to provide an initial overview of this dataset.

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T 82.8 Thu 17:45 Geb. 20.30: 2.058

Exploring eV-Scale Sterile Neutrinos with the KATRIN Experiment — •Shailaja Mohanty for the KATRIN-Collaboration — Institute of Astroparticle Physics, KIT, Karlsruhe, Germany

Sterile neutrinos, though not part of the standard three-neutrino framework, are a crucial component of various physics models. They have the potential to address anomalies observed in short-baseline neutrino oscillations, backed by some theoretical support for their existence. The Karlsruhe Tritium Neutrino (KATRIN) experiment, aiming at 0.3 $\mathrm{eV/c^2}$ (90% C.L.) sensitivity to the neutrino mass, measures the tritium β-decay endpoint spectrum with a high precision. The same spectrum is sensitive to sterile neutrino admixture. This presentation provides the current status of sterile neutrino search in the first five measurement campaigns of KATRIN using the analysis framework “KaFit”. The analysis procedure and sensitivity are discussed, along with assumptions about constraining active neutrino mass and their influence on sterile neutrino sensitivity.

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