# T 91: Neutrinos IV

Time: Wednesday 17:30–19:00 Location: POT/0006

T 91.1 Wed 17:30 POT/0006

**Sensitivity studies of the KATRIN experiment with a differential detector** — •Svenja Heyns for the KATRIN-Collaboration — Institute for Astroparticle Physics, Karlsruhe Institute of Technology

The Karlsruhe Tritium Neutrino Experiment (KATRIN) is designed to probe the neutrino mass with a sensitivity of 0.2 eV/c$^2$ (90% C.L.). The measurement principle relies on an integral measurement of the tritium beta spectrum at the kinematic endpoint of $T_2$ by a high-pass MAC-E-type filter. Switching to a differential measurement of the beta-electron spectrum with eV-scale resolution would increase statistics and allow improved discrimination of background events. This presentation outlines the potential modification to the setup with possible detector concepts and discusses their impact in first studies on neutrino mass sensitivity.

*This work is supported by the Helmholtz Association (HGF), the Ministry for Education and Research BMBF (05A17PM3, 05A17PX3, 05A17VK2, and 05A17WO3), the Helmholtz Alliance for Astroparticle Physics (HAP), and the Helmholtz Young Investigator Group (VH-NG-1055).*

T 91.2 Wed 17:45 POT/0006

**Characterization of a TRISTAN detector with a laser system** — •Christian Forstner for the KATRIN-Collaboration — Technical University Munich, James-Franck-Straße 1, 85748 Garching bei München

Sterile neutrinos are a minimal extension of the Standard Model of particle physics. These neutrinos are a dark matter candidate if their mass is in the keV range. They can be accessed experimentally in the tritium beta decay, if they have a mass of up to 18.6 keV and would manifest themselves as a kink-like distortion in the electron energy spectrum. For the KATRIN experiment, a novel silicon drift detector and read-out system is developed to search for this signal. In this presentation, the results of the characterization of a 7 pixel TRISTAN detector with a laser system will be presented and compared to simulations.

This work is supported by BMBF (05A17PM3, 05A17PX3, 05A17VK2, 05A17WO3), KSETA, the Max Planck society, and the Helmholtz Association. This project has received funding from the European Research Council (ERC) under the European Union Horizon 2020 research and innovation program (grant agreement No. 852845).

T 91.3 Wed 18:00 POT/0006

**The other end of KATRIN – systematic effects by the rear wall** — •Leonard Hasselmann, Max Aker, and Rudolf Sack — IAP, Karlsruher Institut für Technologie

In order to determine the neutrino mass with a sensitivity of 0.2 eV/c$^2$ (90% C.L.) the Karlsruhe Tritium Neutrino (KATRIN) experiment measures the $\beta$-decay endpoint spectrum of tritium using a MAC-E filter type spectrometer. In KATRIN's source $10^{11}$ $\beta$-decay electronss are emitted per second. They are magnetically guided to the spectrometer in one direction and to a gold coated stainless steel plate, named rear wall, to the other.

A comprehensive understanding of various background contributions, e.g. accumulated tritium on the rear wall, is paramount. Decays of absorbed tritium create an additional spectrum which superimposes that of the source. This results in a systematic uncertainty, which is mitigated either by modelling the additional spectrum or by removing the tritium from the rear wall and surrounding surfaces.

The talk presents an overview on a cleaning method using UV/ozone which has been performed three times so far in the KATRIN setup. Besides a good cleaning performance, an influence on the source potential was found. Additionally, results from a test setup further investigating the cleaning effect are discussed.

This work is supported by the Helmholtz Association (HGF), the Ministry for Education and Research BMBF (05A17PM3, 05A17PX3, 05A17VK2, and 05A17WO3).

T 91.4 Wed 18:15 POT/0006

**OSIRIS Upgrade: Solar PP Neutrinos and Neutrinoless Double Beta Decay** — •Arshak Jafar[1], Kai Loo[1,2], Michael Wurm[1], Marcel Büchner[1], Tim Charisse[1], George Parker[1], Oliver Pilarczyk[1], and Timo Enqvist[2] — [1]Johannes Gutenberg University Mainz, Germany — [2]University of Jyvaskyla, Finland

The Jiangmen Underground Neutrino Observatory (JUNO), under construction in southern China, will determine the neutrino mass hierarchy (MH) by observing neutrinos from nuclear reactors at a distance of 53 km. To reach the desired sensitivity ($> 3\sigma$) for MH, the radiopurity of the different detector components plays a crucial role. To ensure the purity of the 20 kt liquid scintillator (LS) target of JUNO, the Online Scintillator Internal Radioactivity Investigation System (OSIRIS) is being constructed. It will monitor the radiopurity of the LS during its production and the filling phase of the central detector of JUNO.

After the filling phase, a plan to repurpose OSIRIS as a standalone detector for studying physics has been put forward, as OSIRIS along with the existing JUNO infrastructure provides a unique chance for low-budget high precision measurements. The OSIRIS upgrade project aims at a precision measurement of the flux of solar pp neutrinos on the few-percent level as well as to test the Majorana nature of neutrinos through neutrinoless double beta decay. The upgrade relies on the use of 20 tons of slow scintillator, either low $^{14}$C or loaded with $0\nu\beta\beta$ isotope, with excellent energy resolution ($\sim$2.5% at 1 MeV), low internal background and sufficient shielding from surrounding radioactivity.

T 91.5 Wed 18:30 POT/0006

**JUNO's sensitivity to geoneutrinos using full Monte Carlo simulation** — •Nikhil Mohan[1,3], Runxuan Liu[2,3], Livia Ludhova[2,3], Anita Meraviglia[1,3], Luca Pelicci[2,3], Mariam Rifai[2,3], Apeksha Singhal[2,3], and Cornelius Vollbrecht[2,3] — [1]GSI Helmholtz Centre for Heavy Ion Research, Darmstadt, Germany — [2]Forschungszentrum Jülich GmbH, Institut für Kernphysik IKP-2, Jülich, Germany — [3]III. Physikalisches Institut B, RWTH Aachen University, Aachen, Germany

JUNO is a multipurpose 20 kton liquid scintillator detector located in China, with planned completion in 2023. Its main physics goal is the determination of the Neutrino Mass Ordering via the measurement of the vacuum oscillation pattern of the reactor antineutrinos coming from two nuclear power plants, each at a 53 km baseline. JUNO is also an excellent candidate to investigate geoneutrinos thanks to its sizable active mass and unprecedented effective energy resolution (3% at 1 MeV). The sensitivity study is performed by producing all the energy reference shapes - signal and backgrounds - using the JUNO official Monte Carlo simulation with a full detector response as well as the reconstruction software. The reference shapes generated from the massive pseudo-experiments are then fitted with JUST (Juelich nUsol Sensitivity Tool), a software tool developed in our group. This study reveals the important role JUNO can have in detecting geoneutrinos. Even only after one year of data-taking, JUNO will be able to reach a 14% precision, thus improving the best current result given by the Borexino and KamLAND experiment.

T 91.6 Wed 18:45 POT/0006

**Neutrino directionality: aims, methods and the reaction of inverse beta decay** — •Yaroslav Nikitenko, Philipp Soldin, Achim Stahl, and Christopher Wiebusch — III. Physikalisches Institut B, RWTH Aachen University

Reconstructing the direction of neutrinos is of high interest for supernovae and geoneutrinos. We discuss existing experimental methods and focus on neutrino directionality using the reaction of inverse beta decay.

While the reaction of neutrino-electron scattering provides a better per-event angular resolution for supernova neutrinos, inverse beta decay usually has many more events. Its detection threshold for existing large detectors is lower than that for electron scattering, which is important for geoneutrinos.

The Double Chooz reactor neutrino experiment provides a good scientific basis to study neutrino directionality with the reaction of inverse beta decay. Its advantage is the neutrino source of a known direction and almost point-like structure.