HK 43: Astroparticle Physics III

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

Gruppenbericht HK 43.1 Mi 16:30 HS 16

From first tritium data towards neutrino mass measurements with the KATRIN Experiment — •Magnus Schlösser for the KATRIN-Collaboration — Karlsruhe Institute of Technology

The KArlsruhe TRitium Neutrino (KATRIN) experiment at the Karlsruhe Institute of Technology aims for a direct neutrino mass determination with a sensitivity of 200 meV/c^2 (90% C.L.). The measurement is performed by precise spectroscopy of the tritium-β-decay electrons near the kinematic endpoint of 18.6 keV. That is achieved by employing a high-resolution ($\Delta E < 1$ eV) MAC-E-type high-pass energy filter coupled to a high-luminosity (10^{11} Bq) windowless gaseous tritium source. In Spring 2018, the first operation of KATRIN with traces of tritium has been successfully conducted. One principal aim of this campaign, the stability of the tritium source at an activity of about 0.5% ($\approx$ 500 MBq) of the nominal level, has been demonstrated. In this talk, the achievements of the first tritium campaign are demonstrated and the first ever high-resolution spectra from tritium beta-decay electrons by KATRIN are presented. Insights into the ongoing KATRIN run are given in which the source activity was stepwise ramped up to the nominal source strength of 10^{11} Bq in order to achieve the targeted statistics for the neutrino mass goal.

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).

HK 43.2 Mi 17:00 HS 16

Results of First Tritium Measurements at the KATRIN Experiment — •Martin Slezák for the KATRIN-Collaboration — Max Planck Institute for Physics, Munich, Germany

The aim of the **Ka**rlsruhe **Tri**tium **N**eutrino (KATRIN) experiment is to search for the effective electron antineutrino mass with a sensitivity of 0.2 eV/c^2 (90 % C.L.) using electrons from tritium β-decay.

First Tritium measurements were taken in Summer 2018 with the goal of commissioning the full KATRIN system with 1 % nominal tritium activity and demonstrating a global system stability on the 0.1 % level. In addition, the data provides the opportunity to investigate the β-spectrum for systematic effects and cross-check the analysis tools and strategies.

This talk gives an overview of the preliminary results from the high-level analysis of First Tritium measurements. In particular, I will discuss different analysis strategies, relevant systematic effects, and stability of the analysis results.

HK 43.3 Mi 17:15 HS 16

Backgrounds in KATRIN — •Anna Pollithy for the KATRIN-Collaboration — Technische Universität München, Fakultät für Physik, 85748 Garching

The Karlsruhe Tritium Neutrino (KATRIN) experiment is designed to determine the effective electron anti-neutrino mass with a sensitivity of 200 meV/c^2 (90% C.L.) by investigating the energy spectrum of tritium beta-electrons near the endpoint. For the full neutrino mass sensitivity a very low background level of 10^{-2} cps is required. The residual background shows characteristics that point towards ionization of highly excited 'Rydberg' atoms as a potential background source. These 'Rydberg' atoms can be created by radioactive decays in the walls. In this contribution dedicated measurements to investigate this kind of background creation mechanism will be presented. This work is supported by the SFB1258 and the Max Planck Society.

HK 43.4 Mi 17:30 HS 16

Measurement of KATRINs energy loss function using a time of flight method — •Caroline Rodenbeck and Rudolf Sack for the KATRIN-Collaboration — WWU Münster

The **Ka**rlsruhe **Tri**tium **N**eutrino experiment (KATRIN) is a next generation tritium beta decay experiment improving the sensitivity on direct neutrino mass measurements by one order of magnitude over the predecessor experiments. It allows a model independent investigation of the absolute neutrino mass scale with an estimated sensitivity of 0.2 eV/c^2 (90% C.L.)

Understanding energy losses of electrons inside the windowless gaseous tritium source (WGTS) of KATRIN is essential for measuring the tritium beta decay spectrum with the required precision. The electrons can scatter elastically and inelastically off tritium molecules in the WGTS loosing energy in the process and resulting in a modification of the spectrum.

The talk presents a high resolution measurement of the shape of this energy loss function, which was obtained using a time of flight method with monoenergetic electrons from a photoelectron source at the endpoint energy of the tritium beta spectrum of 18.6 keV.

This work is funded by DFG through the Research Training Group 2149 and by BMBF under contract number 05A17PM3.

HK 43.5 Mi 17:45 HS 16

KATRIN analysis with the covariance matrix approach — •Lisa Schlüter for the KATRIN-Collaboration — MPP München

The KArlsruhe TRItium Neutrino (KATRIN) experiment is designed to determine the effective mass of the electron-antineutrino with an sensitivity of 200 meV/c^2 (90% C.L.) in a direct and model-independent way. The neutrino mass can be inferred from the shape of the endpoint region of the tritium β-decay spectrum, which is measured using a MAC-E filter and a Windowless Gaseous Tritium Source (WGTS). This talk presents an analysis of the KATRIN Tritium commissioning measurements, including systematic effects based on the covariance matrix approach, using the Samak simulation analysis package.

HK 43.6 Mi 18:00 HS 16

TRISTAN measurements at Troitsk nu-mass experiment — •Tim Brunst for the KATRIN-Collaboration — Max Planck Institute for Physics — Technical Universtity of Munich

The KATRIN (Karlsruhe Tritium Neutrino) experiment investigates the energetic endpoint of the tritium beta-decay spectrum to determine the effective mass of the electron anti-neutrino with a sensitivity of 200 meV (90% C.L.) after an effective data taking time of three years. The TRISTAN (tritium beta-decay to search for sterile neutrinos) group aims at detecting a sterile neutrino signature by measuring the entire tritium beta-decay spectrum with an upgraded KATRIN system. One of the greatest challenges is to handle the high signal rates generated by the strong activity of the KATRIN tritium source. Therefore, a novel multi-pixel silicon drift detector is being designed which is able to handle rates up to 100 Mcps with an excellent energy resolution for electrons of 300 eV (FWHM) at 10 keV. First seven-pixel prototype detectors were successfully installed and operated at the Troitsk nu-mass experiment, one of KATRIN's technological predecessors. This talk presents the results of these measurement campaigns.

HK 43.7 Mi 18:15 HS 16

Characterization of the TRISTAN prototype detectors with electrons — •Daniel Siegmann for the KATRIN-Collaboration — Max Planck Institut for Physics — Föhringer Ring 6

The KATRIN (Karlsruhe Tritium Neutrino) experiment investigates the energetic endpoint of the tritium beta-decay spectrum to determine the effective mass of the electron anti-neutrino with a sensitivity of 200 meV (90% C.L.) after an effective data taking time of three years starting in March 2019.

After the data taking for the neutrino mass survey is completed the TRISTAN (TRitium Invetigations of STerile to Active Neutrino mixing) project will upgrade the current detector in the KATRIN experiment to search for the signature of a keV sterile neutrino in the entire tritium beta decay spectra. One of the greatest challenges is to handle high signal rates as a result of the strong activity of the KATRIN tritium source. Therefore, a novel 3500 multi-pixel silicon drift detector is being designed which is able to handle rates up to 100 kcps in each pixel while maintaining an excellent energy resolution of 300 eV (FWHM) at 20 keV.

To fulfill these requirements in the future multiple smaller 7 channel prototypes were designed and characterized. The investigation of various detector entrance window technologies and their effect on the detector response for electrons are discussed in this talk.

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