T 6: Neutrinomasse I

Zeit: Montag 11:00–12:35 Raum: VMP5 SR 0079

Gruppenbericht T 6.1 Mo 11:00 VMP5 SR 0079

Status of the KATRIN experiment — •Marco Röllig for the KATRIN-Collaboration — Karlsruher Institut für Technologie (KIT), Deutschland

A model-independent measurement of the neutrino mass is one of the most important open issues in neutrino physics. The KArlsruhe Tritium Neutrino Experiment (KATRIN) aims for it with an unprecedented sensitivity of $m_{\bar{\nu}_e} < 200$ meV (90% C.L.). While the commissioning of the high resolution MAC-E Filter and the main detector is ongoing also all tritium related components have arrived at KIT. At the Tritium Laboratory Karlsruhe the on-site finalization and commisioning of the tritium related parts has started. A status report on all source and transport components of KATRIN as well as the spectrometer and detector section is given. Also the integration into the existing tritium infrastructure is described.

T 6.2 Mo 11:20 VMP5 SR 0079

Project8: ein neuer Ansatz zur Bestimmung der Neutrinomasse — •Christine Claessens und Sebastian Böser — Johannes Gutenberg-Universität Mainz

Obwohl das Konzept der Zyklotron-Strahlung seit über einem Jahrhundert bekannt ist, wurde diese aufgrund der geringen abgestrahlten Leistung bislang nicht für einzelne Elektronen beobachtet. Durch den Einschluss der Elektronen in einer magnetischen Falle und den so erreichbaren langen Integrationszeiten ist dem Project8-Experiment vor kurzem die direkten Beobachtung der Zyklotron-Strahlung einzelner schwachrelativistischer Elektronen gelungen. Die präzise Vermessung der Zyklotronfrequenz $f = \frac{eB}{2\pi\gamma m_e}$ erlaubt dabei eine hochpräzise Energiebestimmung einzelner Elektronen in-situ, und etabliert so das neue Feld der *Cyclotron-Radiation Emission Spectroscopy* (CRES). Eine vielversprechende Anwendung dieser neuartigen Detektionsmethode ist insbesondere die Vermessung des β-Zerfallsspektrums von Tritium zur Bestimmung der Neutrinomasse. Die Ergebnisse erster Messungen der CRES und neue Ansätze zur weiteren Verbesserung der Energiebestimmung werden vorgestellt.

T 6.3 Mo 11:35 VMP5 SR 0079

Background Analysis and Reduction for the ECHo Experiment — •Stephan Scholl for the ECHo-Collaboration — Kepler Center for Astro and Particle Physics, Eberhard-Karls Universität Tübingen

ECHo–1K is a new experiment designed for the investigation of the electron Neutrino mass with the microcalorimetric measurement of the electron capture spectrum of ^{163}Ho. In this presentation, an overview of our Monte–Carlo background simulations and our radiopurity measurements is given.

T 6.4 Mo 11:50 VMP5 SR 0079

Radon-induced backgrounds in the KATRIN Main Spectrometer — •Fabian Harms for the KATRIN-Collaboration — Karlsruhe Institute of Technology (KIT), Institute for Experimental Nuclear Physics (IEKP)

The KArlsruhe TRItium Neutrino (KATRIN) experiment aims to determine the effective mass of the electron anti-neutrino with a sensitivity of 200 meV/c^2 (90% C.L.) by investigating the kinematics of tritium β-decay. One crucial prerequisite to reach this unsurpassed sensitivity is a background level of ≤ 0.01 counts per second within the 1240-m^3 vessel of the KATRIN Main Spectrometer.

In 2014/15, a dedicated series of commissioning measurements was performed in order to identify and characterize the various background sources in the spectrometer. This talk will focus on background generating processes that do follow the radioactive decays of radon atoms in the vessel volume. Besides a well-understood stored-electron induced background that is caused by the decay of the short-lived isotopes ^{219}Rn and ^{220}Rn, this also includes a newly identified background contribution due to a deposition of the progeny of the long-lived isotope ^{222}Rn on inner surfaces of the spectrometer. The characteristics of both background contributions, possible countermeasures, and the consequences for the absolute background level of KATRIN will be discussed.

This work has been supported by the Helmholtz Association and the German BMBF (05A14VK2).

T 6.5 Mo 12:05 VMP5 SR 0079

Gamma induced background in the KATRIN main spectrometer — •Philipp Chung-On Ranitzsch for the KATRIN-Collaboration — Institut für Kernphysik, Universität Münster

The *KA*rlsruhe *TRI*tium *N*eutrino experiment (KATRIN) experiment aims to measure the electron neutrino mass with a sensitivity of $m(\nu_e) < 200\,\mathrm{meV}/c^2$. It utilizes a MAC-E-type spectrometer for high-resolution and high-statistics spectroscopy of the β-decay of ^{3}H close to its endpoint of 18.6 keV.

The KATRIN spectrometer and detector section has undergone 3 commissioning phases in recent years, with one of the major goals being the characterization and reduction of the background level. Secondary electrons, that are created inside the main spectrometer by external radiation, e.g. cosmic muons or natural radioactivity gammas, are considered to be one of the main contributions to the remaining background level.

The experimental investigation of the gamma induced background has been twofold. Firstly by exposing the spectrometer wall to an external 50 MBq ^{60}Co gamma source and secondly by introducing additional gamma shielding inside the experimental hall, effectively reducing the flux of natural radioactivity gammas to the spectrometer wall.

This talk gives an overview of the investigations and results concerning gamma induced background in the KATRIN main spectrometer.

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T 6.6 Mo 12:20 VMP5 SR 0079

Vacuum simulation of the KATRIN radon background — •Joachim Wolf for the KATRIN-Collaboration — Karlsruher Institut für Technologie (KIT), IEKP, Postfach 3640, 76021 Karlsruhe

The objective of the KATRIN experiment at KIT is the measurement of the electron neutrino mass. A central component is the Main Spectrometer (1240 m^3), where the energy of the β-electrons from tritium decay (18.6 keV) will be measured close to the endpoint of the spectrum. The pumping system of the ultra-high vacuum vessel consists of turbo-molecular pumps, a large-scale getter pump (up to 3000 m NEG strips, St707) and three cryo-baffles at LN_2 temperature, designed to maintain a pressure in the range of 10^{-11} mbar. The NEG strips, as well as the stainless steel walls are known to emanate small amounts of radon atoms, increasing the intrinsic background rate, which would limit the sensitivity for the neutrino mass. The cryogenic copper baffles in front of the NEG pumps capture most of the radon, before it decays in the main volume. However, radon does not stick to the cold surface indefinitely. If it desorbs after a limited residence time, it can contribute again to the background rate.

This talk describes the simulation of this radon background with the Test-Particle Monte Carlo (TPMC) code MolFlow+ and compares the results with measurements. We modified the original MolFlow+ code, and added two new, time-dependent features, (i) a finite residence time for all adsorbing surfaces, and (ii) a finite half-life of the test particles. Results are presented for different radon isotopes. This work has been supported by the German BMBF (05A14VK2).