# HK 35: Astroteilchenphysik

Zeit: Mittwoch 16:30–18:45 Raum: HZ 9

HK 35.1 Mi 16:30 HZ 9

**Experimental Determination of the Antineutrino Spectrum of the Fission Products of U238** — •Nils Haag, Achim Gütlein, Martin Hofmann, Walter Potzel, and Lothar Oberauer — Technische Universität München, 85748 Garching

Accurate predictions of the antineutrino spectrum emitted by a nuclear reactor are of paramount importance for current and future reactor neutrino experiments. The antineutrinos are produced in the $\beta$ - decays of the fission daughters of the four main fuel isotopes $^{235}$U, $^{238}$U, $^{239}$Pu, and $^{241}$Pu. One way to calculate the total $\bar{\nu}_e$ - spectrum emitted by a fuel assembly is to experimentally determine the cumulative $\beta$ - spectra emitted after fission of these four main fuel isotopes and to convert these into the corresponding $\bar{\nu}_e$ - spectra. Three of the four spectra could already be determined in the 1980's, but only recently an experiment at the scientific neutron source FRM II in Garching could be performed to measure the $\bar{\nu}_e$ - spectrum of $^{238}$U which contributes 10 % to the total antineutrino output of a standard PWR. With this spectrum, it is now possible to predict the antineutrino output of a reactor without the use of theoretical calculations for the contribuing spectra.
This talk describes the results of the experiment and discusses the impact on the current analysis of reactor neutrino experiments and the reactor antineutrino anomaly, which may give a hint on the possible existence of light sterile neutrinos.

HK 35.2 Mi 16:45 HZ 9

**Measurements of Proton- and Electron-Quenching in Organic Liquid Scintillators** — •Vincenz Zimmer, Paul Hackspacher, Dominikus Hellgartner, Lothar Oberauer, Ludwig Prade, and Jürgen Winter — Technische Universität München

Understanding quenching effects in organic liquid scintillators is vital for various present and future neutrino experiments, like Double Chooz, Borexino, LENA and JUNO.

Electron-quenching plays a crucial role for low energy electron events below about 500 keV, like electron recoil events from Compton-scattering and from $\nu$-$e$-scattering - especially for solar $pp$-neutrino events. To measure this effect a coincidence experiment using a scintillation detector and a HPGe-detector has been set up and the analysis of first data shows promising results.

The understanding of proton-quenching is important for both signal and background detection in neutrino experiments. This effect defines the energy scale of $\nu$-$p$-scattering, which is a major detection channel for supernova-$\nu$s. Furthermore, recoil protons from cosmogenic neutrons pose a severe background for the detection of the diffuse supernova neutrino background (DSNB) and reactor neutrinos. A time-of-flight based experiment has been established at the MLL (Garching). Using a pulsed $^{11}$B-beam and a fixed $H_2$-target neutrons with $6-11$ MeV are produced to investigate the quenching effect by the resulting proton recoils in different liquid scintillator samples.

This research was supported by the DFG cluster of excellence 'Origin and structure of the Universe' and the Maier-Leibnitz-Laboratorium.

HK 35.3 Mi 17:00 HZ 9

**Performance des Fokalebenendetektors während der Inbetriebnahme des KATRIN Hauptspektrometers** — •Fabian Harms für die KATRIN-Kollaboration — Karlsruher Institut für Technologie, Institut für Experimentelle Kernphysik

Das Ziel des **Ka**rlsruher **Tri**tium **N**eutrino Experiments ist die modellunabhängige Bestimmung der effektiven Ruhemasse des Elektron-Antineutrinos mit einer bis dato unerreichten Sensitivität von 200 meV/c$^2$ (90% C.L.). Dies geschieht mittels der kinematischen Untersuchung der Elektronen aus dem Tritium $\beta$-Zerfall durch ein auf dem MAC-E Filter Prinzip basierendes Spektrometer. Der KATRIN Fokalebenendetektor (FPD) - bestehend aus einer Si-PIN Diode mit 148 Segmenten - ist Teil des MAC-E Filters und weist die vom Spektrometer transmittierten Elektronen mit hoher Effizienz und nahezu untergrundfrei nach.
Im Laufe des Sommers 2013 wurde das KATRIN Hauptspektrometer für eine dreimonatige Messphase erstmals in Betrieb genommen. Dabei war insbesondere die Langzeit-Performance des Fokalebenendetektors entscheidend für den Erfolg dieser Messphase.
Neben einer Übersicht über den Aufbau des Fokalebenendetektor-Systems wird in diesem Beitrag die Performance des Detektors während der Spektrometer Inbetriebnahme zusammengefasst.
Gefördert durch das BMBF unter dem Kennzeichen 05A11VK3 und von der Helmholtz-Gemeinschaft.

HK 35.4 Mi 17:15 HZ 9

**Main Spectrometer and Detector Commissioning Measurements by Time-of-Flight at the KATRIN experiment** — •Nicholas Steinbrink, Volker Hannen, Jan Behrens und Christian Weinheimer für die KATRIN-Kollaboration — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster, Wilhelm-Klemm-Str. 9, 48149 Münster

The KATRIN experiment aims to measure the electron neutrino mass with a sensitivity of $< 0.2$ eV at 90% confidence level. The measurement is accomplished by scanning the endpoint of the tritium beta decay spectrum with an electrostatic high pass filter, based on the MAC-E-Filter (magnetic adiabatic collimation with an electrostatic filter) principle. The filtering takes place in the main spectrometer of KATRIN while the count-rate as a function of the filter energy is measured with the focal plane detector (FPD).

The whole spectrometer and detector system (SDS) has undergone successful commissioning measurements in 2013. For that purpose, a mono-energetic angular selective electron gun has been used as calibration source. As the electron gun is driven in a pulsed mode, the time-of-flight (TOF) of electrons through the main spectrometer can be measured as well. That allows to obtain further information about the performance and functionality of the setup. In this talk results from the TOF measurements are presented. Particular emphasis will be put on the integrity of the wire electrode, which can be probed by TOF data.

This work is supported by BMBF under 05A11PM2.

HK 35.5 Mi 17:30 HZ 9

**Messungen der Transmissionseigenschaften des KATRIN Hauptspektrometers** — •Moritz Erhard für die KATRIN-Kollaboration — Karlsruher Institut für Technologie (KIT), Institut für experimentelle Kernphysik (IEKP)

Ziel des Karlsruher Tritium Neutrino Experiments ist es, durch eine Endpunktsuntersuchung des $\beta$-Zerfallsspektrums von Tritium die effektive Masse des Elektronantineutrinos direkt und modellunabhängig mit einer Sensitivität von 200 meV/c$^2$ (90% CL) zu bestimmen. Um diese hohe Sensitivität zu erreichen wird das KATRIN Hauptspektrometer mit dem MAC-E-Filter (Magnetic Adiabatic Collimation followed by Electrostatic Filter) Prinzip betrieben.

Die Kenntnis der genauen Transmissionseigenschaften des Hauptspektrometers ist für die spätere Interpretation der Tritiumdaten und Extraktion der Neutrinomasse von großer Wichtigkeit.

Bei der Inbetriebnahme des Spektrometers im Sommer 2013 wurden mithilfe einer Elektronenkanone Messungen der Transmissionseigenschaften des Hauptspektrometers durchgeführt. Die gewonnenen Daten werden in diesen Vortrag präsentiert.

Gefördert durch das BMBF unter Kennzeichen 05A11VK3, 05A11PM2 und die Helmholtz-Gemeinschaft.

HK 35.6 Mi 17:45 HZ 9

**Background due to secondary electron emission in the KATRIN experiment** — •Benjamin Leiber and Ferenc Glück — Karlsruhe Institute of Technology, IKP and IEKP

The aim of the KATRIN experiment is to determine the absolute neutrino mass scale in a model independent way, by measuring the electron energy spectrum shape near the endpoint of tritium beta decay. An ultra-low background level of 10 mHz is necessary to reach the design sensitivity of 200 meV. A significant part of the background is due to cosmic muon and/or environmental gamma induced secondary electron emission from the vessel inner wall and electrode surfaces of the KATRIN main spectrometer. The secondary emission rates in the KATRIN pre-, monitor and main spectrometers have been determined by a combination of measurements and simulations. In the case of the main spectrometer this rate is about 50 kHz. Due to the magnetic shielding effect, the background rate is several orders of magnitude smaller than the above secondary emission rate. The background reduction of the magnetic shielding can be improved by improving the axial symmetry of the magnetic and electric fields inside the main spectrometer. In addition, the background rate due to the secondary electron emission can be further reduced with the help of electric shielding realized by the wire electrode system inside the main spectrometer.

We acknowledge support by the BMBF of Nr. 05A11VK3 and by the Helmholtz Association.

HK 35.7 Mi 18:00 HZ 9

**Radon backgrounds in the KATRIN experiment** — •Richard Rink, Stefan Görhardt, and Jan Oertlin for the KATRIN-Collaboration — Karlsruhe Institute of Technology (KIT), Institut für Kernphysik (IKP)

The KATRIN experiment aims to determine the effective mass of the electron anti-neutrino with a sensitivity of 200 meV by investigating the kinematics of tritium $\beta$-decay. In order to achieve this sensitivity, the overall background of the experiment needs to be on the order of 0.01 counts per second.

The decay of radon atoms, which emanate from different sources inside the spectrometer, produces high energy (order of 10 keV) electrons. These electrons can be stored inside the spectrometer because of the magnetic mirror effect and create a large number of secondary electrons via ionization of the residual gas. The secondaries are accelerated by the electric potential and therefore will have the same energy as the signal electrons from $\beta$-decays by the time they arrive at the detector.

This talk will present investigations of radon-induced backgrounds during the recent commissioning measurement phase of the KATRIN main spectrometer and discuss the efficiency of counter measures.

This work was supported by the BMBF under grant no. 05A11VK3 and by the Helmholtz Association.

HK 35.8 Mi 18:15 HZ 9

**Messung der Langzeitstablilität verschiedener Rb/Kr-Quellen am KATRIN Monitorspektrometer** — •Ingo Reuter für die KATRIN-Kollaboration — Karlsruher Institut für Technologie (KIT), Insititut für experimentelle Kernphysik (IEKP)

Das Ziel des KArlsruher TRItium Neutrino Experiments KATRIN ist die Bestimmung der effektiven Masse des Elektron-Antineutrinos, mit einer bisher unerreichten Sensitivität von 200 meV/c$^2$. Für das Experiment ist ein Spektrometer nach dem MAC-E-Filter Prinzip aufgebaut worden, um das Energiespektrum der Tritium-Zerfallselektronen nahe ihres Endpunkts zu vermessen. Damit diese Sensitivität über die gesamte Messzeit gewährleistet werden kann, ist eine langzeitstabile Spannungsüberwachung und Kalibration erforderlich mit einer Unsicherheit von 60 meV über zwei Monate bei -18,6 kV. Hierzu werden am Monitorspektrometer, auch einem MAC-E-Filter, monoenergetische Konversionselektronen einer Rb/Kr Quelle gemessen. Das Rb wird durch Ionenimplantation in ein Substrat eingebracht. Dieser Vortrag gibt einen Überblick über die Eignung verschiedener Substrate für eine solche Kalibrationsquelle. Gefördert durch das BMBF unter der Kennzeichnung 05A11VK3 und der Helmholtz-Gemeinschaft.

HK 35.9 Mi 18:30 HZ 9

**Status report on the tritium source-related components of the KATRIN experiment** — •Martin Babutzka, Markus Steidl, and Michael Sturm for the KATRIN-Collaboration — Karlsruher Institut für Technologie (KIT)

The KArlsruhe Tritium Neutrino Experiment (KATRIN) aims for the direct model-independent neutrino mass measurement with a sensitivity of $m_{\bar{\nu}_e} < 200\,\text{meV}$ (90% C.L.). While the commissioning of the high resolution MAC-E filter has already started, some of the tritium related components are still in the finishing stage at the manufacturers. We give a status report on all source and transport components of KATRIN as well as all related tritium processing and analytic intruments at the Tritium Laboratory Karlsruhe. Additionally we describe the improvements in simulations and our program to characterize the components in advance of tritium data taking. This is of special importance as the statistical and systematic uncertainties of the $m_{\bar{\nu}_e}$ measurement are closely related to the performance and stability of the windowless gaseous tritium source - as well to the functionality of the transport section, which has to reduce the tritium flow by 14 orders of magnitude in order to avoid backgrounds and to the performance of monitoring systems which are able to detect changes in the source parameters down to a precision of 0.1 %.