T 31: Neutrinophysik VI

Zeit: Dienstag 16:30–19:00 Raum: Z6 - HS 0.001

T 31.1 Di 16:30 Z6 - HS 0.001

Ion monitoring in the KATRIN experiment — •Manuel Klein for the KATRIN-Collaboration — Karlsruhe Institute of Technology (KIT), ETP, Postfach 3640, 76021 Karlsruhe

The KArlsruhe TRItium Neutrino (KATRIN) experiment aims at the model-independent measurement of the electron neutrino mass. It is designed for a neutrino mass sensitivity of 0.2 eV (90% CL) after three full years of measurement time. KATRIN measures the end point of the tritium beta-decay spectrum using a MAC-E filter and a Windowless Gaseous Tritium Source (WGTS). While neutral tritium gas molecules are pumped out from the beamline, decay electrons are guided to the detector by strong magnetic fields. Tritium ions, however, would also follow the magnetic field lines to the Pre- and Main Spectrometer, where they could cause background by ionisation and contamination. Preventing this is imperative for KATRIN measurements.

Ring electrodes in the transport section will block the tritium ions via positive electric potentials. These potentials could possibly be neutralised by negative space charges. Several ion detection methods therefore will monitor the residual ion flux, with specific advantages in terms of sensitivity, continuous availability and systematics. The most sensitive method is observation of the background from tritium ions by ionisation of residual gas in the spectrometers. Other ion detection methods are based on Fourier Transform Ion Cyclotron Resonance (FT-ICR) and Faraday Cup measurements of neutralisation currents.

Supported by research training group GRK 1694, the YIG VH-NG-1055, BMBF (Ø05A17VK2) and the Helmholtz Association.

T 31.2 Di 16:45 Z6 - HS 0.001

Investigation of ion-induced background processes in the KATRIN spectrometers — •Woo-Jeong Baek for the KATRIN-Collaboration — Hermann-von-Helmholtz-Platz 1 Building 402, Room 206 76344 Eggenstein-Leopoldshafen, Germany

The KArlsruhe TRItium Neutrino (KATRIN) experiment targets the determination of the effective electron (anti-)neutrino mass with a sensitivity of 0.2eV/c^2 by means of a precise measurement of the tritium β electron energy spectrum close to the endpoint. The experimental setup of KATRIN consists of a windowless gaseous tritium source (WGTS), the cryogenic and differential pumping sections ensuring the transport of the signal electrons, the MAC-E filter based electrostatic pre- and main spectrometer followed by the focal plane detector which enables the measurement of the transmitted electrons. The required sensitivity on the neutrino mass limits the allowed nominal background rate to 10 mcps. In order to achieve this goal, a detailed understanding of background processes such as the generation of low energy electrons due to positive ions is essential. In addition to the simulation of the ion transport along the KATRIN beamline, scattering processes of different ion species on residual gas molecules were investigated via simulations in the spectrometer section to gain a deeper knowledge on this background causing mechanism. The results will be presented focusing on the characteristics of ion-induced background processes.

This work has been supported by BMBF (05A17VK2).

T 31.3 Di 17:00 Z6 - HS 0.001

Azimuthal Investigation of Spectrometer Background in the KATRIN Experiment — •Fabian Block for the KATRIN-Collaboration — Karlsruhe Institute of Technology (KIT), IKP, Hermann-von-Helmholtz-Platz 1, Building 402 Room 206, 76344 Eggenstein-Leopoldshafen

The **Ka**rlsruhe **Tri**tium **N**eutrino (KATRIN) experiment will investigate the endpoint region of the β decay spectrum to determine the effective electron anti-neutrino mass with a sensitivity of 200 meV/c^2 (90% C.L.). Therefore the β electrons are magnetically guided from the windowless gaseous tritium source through the transport and pumping section towards the tandem spectrometer section. In the tandem spectrometer section, consisting of a pre- and main spectrometer, only the electrons near the energetic endpoint of the β decay spectrum are transmitted to the focal plane detector. In order to reach the aimed sensitivity goal a thorough understanding of the background processes in both spectrometers is needed.

In this talk the results of detailed investigations of the spatial background distribution gained in long-term measurements with the full spectrometer and detector section set-up of KATRIN are presented. Especially the azimuth angle distribution is examined with statistical methods with regard to a misalignment between the spectrometer background and the focal plane detector. Furthermore a hint to a spatial deformation of the background is presented.

This work was supported by BMBF (05A17VK2) and the HGF.

T 31.4 Di 17:15 Z6 - HS 0.001

Another look at KATRIN's response function for isotropic and mono-energetic sources* — •Lukas Voss for the KATRIN-Collaboration — Bergische Universität Wuppertal

The KArlsruhe TRItium Neutrino (KATRIN) experiment aims to measure the effective electron neutrino mass in a model-independent way with a sensitivity of 200 meV/c^2 (90 % C.L.).

Electrons are emitted isotropically in the Windowless Gaseous Tritium Source (WGTS) and guided by magnetic fields through the transport section and the two spectrometers. They are detected when they reach the focal plane detector (FPD). While the electrons travel towards the detector, their energy and angle to the guiding field are being influenced by elastic and inelastic scattering.

With help of KATRIN's software package KASSIOPEIA the response function of the experiment is simulated. The response function is governed by the energy resolution and includes energy losses by elastic and inelastic scattering. Thereby, the expected spectral shape for isotropically emitted electrons, and electrons originating from an electron-gun at varying tritium cross-sections are investigated as well as the feasibility of full MC simulation of the response-function in KATRIN.

The results of the simulation are discussed in this talk.

* Gefördert durch das BMBF.

T 31.5 Di 17:30 Z6 - HS 0.001

Bayesian Analysis of the KATRIN Krypton Calibration Data — •Martin Ha Minh for the KATRIN-Collaboration — Max Planck Institute for Physics — Technical University Munich

The KArlsruhe TRItium Neutrino (KATRIN) Experiment is a large-scale experiment for the model-independent determination of the effective mass of the electrin-antineutrino with a sensitivity of 200 meV/c^2 (90% C.L.). It investigates the tritium β-decay close to the kinematic endpoint of the energy spectrum with a high-resolution electrostatic spectrometer (ΔE = 0.93 eV at 18.6 keV).

A gaseous ^{83}Kr source has been introduced into the KATRIN experiment in summer 2017. Due to the krypton's emission of monoenergetic conversion electrons and its behavior similar to the tritium gas it is ideal to be used for calibration purposes. This talk discusses the analysis of this first calibration campaign based on a Bayesian approach. Special focus will be on the study of systematic effects.

This work is supported by the Max Planck Institute for Physics.

T 31.6 Di 17:45 Z6 - HS 0.001

Development of a MC Generator for the KATRIN Experiment — •Christian Karl for the KATRIN-Collaboration — Max-Planck-Institut für Physik, Föhringer Ring 6, 80805 München

The **Ka**rlsruhe **Tri**tium **N**eutrino (KATRIN) experiment is designed to determine the effective electron anti-neutrino mass with a sensitivity of $m_\nu = 0.2\,\mathrm{eV/c^2}$ (90% C.L.) via the kinematics of tritium β-decay. As a means to test, optimize, and validate the data analysis tools a Monte Carlo (MC) generator has been developed.

A MC generator produces artificial data sets by simulating the model theoretically and applying statistical smearing. As the true values of the physics parameters are known this provides a powerful tool to test analysis tools.

This talk will present the functionality and use cases of a MC generator for the KATRIN experiment. These include testing the fitting tools, the effect of various systematics on the neutrino mass measurement and the capability of different data blinding methods.

T 31.7 Di 18:00 Z6 - HS 0.001

Alignment simulations for the KATRIN experiment — •Marco Deffert for the KATRIN-Collaboration — Karlsruhe Institute of Technology (KIT), ETP, Postfach 3640, 76021 Karlsruhe

The **Ka**rlsruhe **Tri**tium **N**eutrino (KATRIN) experiment aims to determine the effective neutrino mass with a sensitivity of $m_\nu = 0.2\,\mathrm{eV/c^2}$ (90% C.L.) by measuring the energy of electrons from the tritium β-decay. The β-electrons produced in the windowless gaseous tritium source (WGTS) are magnetically guided through the beamlines of the transport and pumping section to the huge main spectrometer for energy measurement. In the center of the main spectrometer, the so called analyzing plane, the magnetic field is minimal and the electric retarding potential is maximal. In order to get the exact potential for each detector pixel, the trajectory of the electrons is simulated backwards from the detector to the analyzing plane. The simulations include all known misalignment of magnetic coils and beam tube elements but up to now, uncertainties on these misalignments were not taken into account. A first attempt to include uncertainties in the simulations for the KATRIN experiment and resulting systematics on the potential will be presented. This work was supported by KSETA.

T 31.8 Di 18:15 Z6 - HS 0.001

SAMAK: new analysis software for the KATRIN experiment — •Pablo Israel Morales Guzman for the KATRIN-Collaboration — Max Planck Institute für Physik — Technische Universität München

The purpose of the KArlsruhe TRItium Neutrino (KATRIN) experiment is to measure the neutrino mass with a sensitivity of 200 meV/c^2 with a 90 % C.L., by observing the spectrum of tritium beta decay electrons near the endpoint. It could also set stringent constraint on the existence of light sterile neutrinos.

The KATRIN experiment is set to start collecting data later this year (2018). As a mean of analysis validation, several independent tools were developed within the KATRIN collaboration. One of these tools is the Simulation and Analysis with Matlab in KATRIN (SAMAK, castle in Czech). SAMAK is a new software developed to simulate and fit the tritium beta decay spectrum, with the incorporation of the state of the art of the modeling of the spectrum, including the decay to the excited states of all tritium isotopologue molecules, for instance.

In this talk an overview of SAMAK will be given. As an example, we will discuss the measurement of the effective tritium beta decay endpoint in KATRIN, with both first light and whole 3y dataset.

T 31.9 Di 18:30 Z6 - HS 0.001

Cross-check of KATRIN simulation and analysis tools — •Dominik Fuchs for the KATRIN-Collaboration — Max Planck Institute for Physics — Technical University of Munich

The **Ka**rlsruhe **Tri**tium **N**eutrino (KATRIN) experiment is designed to determine the effective electron anti-neutrino mass with a sensitivity of 200 meV/c^2 (90% C.L.) by the investigation of the kinematics of tritium beta decay in a direct and model independent way.

The modeling of the spectrum is based on theoretical calculations using Fermi theory combined with properties of the experimental setup. Those properties include e.g. scattering of electrons in the source as well as spectrometer and detector responses.

Due to the high complexity of the modeling and fitting of the experimental data, a validation of the analysis tools is essential. For this purpose a procedure has been developed which is mainly based on comparisons of independent sofware. This talk will present the basic philosophy of the KATRIN validation procedure and show the results of a first detailed comparison of two independent KATRIN analysis tools.

T 31.10 Di 18:45 Z6 - HS 0.001

Determination of the tritium Q-value at the KATRIN Experiment — •Rudolf Sack — Westfälische Wilhelms-Universität

The **Ka**rlsruhe **Tri**tium **N**eutrino (KATRIN) experiment is a next Generation tritium β-decay experiment which will allow a model independent investigation of the sub eV neutrino mass scale. With an estimated sensitivity of $0.2\,\mathrm{eV/c^2}$ (90% C.L.) it will improve the sensitivity of direct neutrino mass measurements by one order of magnitude. To reach this goal, it is important to understand the systematic uncertainties of this experiment. The measurement of the Q-value of tritium β-decay at KATRIN, which is closely related to the endpoint E_0 of the electron energy spectrum, can be compared to results of Penning trap experiments, by the group of EG Meyers et al., who published this value with an uncertainty of only $70\,meV$. This will allow us to check the systematics of the experiment, assuming that we can control our energy scale at this level. The estimated statistical error will be $\Delta E_0 = 2 - 3\,meV$ after an effective three years of measurement time. This work was supported by the DFG Graduate School 2149.