HK 49: Astroparticle Physics III

Zeit: Donnerstag 14:00–16:00 Raum: S1/01 A02

Gruppenbericht HK 49.1 Do 14:00 S1/01 A02

Status des KATRIN-Experiments und aktive Methoden zur Untergrundreduktion — •Jan David Behrens für die KATRIN-Kollaboration — Institut für Kernphysik, Wilhelm-Klemm- Str. 9, 48149 Münster

Durch das **KA**rlsruhe **TRI**tium **N**eutrino-Experiment soll die Masse des Elektron-Antineutrinos mit einer Sensitivität von 200 meV/c^2 (90% C.L.) bestimmt werden. Die Vermessung der Form des Tritium-β-Spektrums im Endpunktbereich ermöglicht eine modellunabhängige Bestimmung dieses wichtigen Parameters.

Das Experiment besteht besteht aus einer gasförmigen Tritiumquelle, von der die Zerfallselektronen magnetisch durch differentielle und kryogene Pumpstrecken geführt werden. Die Energieanalyse der Elektronen erfolgt in einem Tandem aus elektrostatischen Spektrometern, die nach dem Prinzip des MAC-E-Filters arbeiten. Dort gespeicherte Elektronen und Ionen können zu einem erhöhten Untergrund führen. Eine Möglichkeit zur Untergrundreduktion ist das aktive Entfernen von gespeicherten Elektronen durch Erzeugung eines elektrischen Dipolfeldes oder eines magnetischen Pulses, um die Speicherbedingungen aufzuheben.

Der Vortrag gibt einen Überblick des aktuellen Status des KATRIN-Experiments mit Fokus auf die Ergebnisse der zweiten Inbetriebnahmephase des Hauptspektrometers und Detektors im Jahr 2014/2015. Außerdem wird die Methode des magnetischen Pulses zur Untergrundreduktion vorgestellt. Dieses Projekt wird unter dem Kennzeichen 05A14PMA durch das BMBF gefördert.

Gruppenbericht HK 49.2 Do 14:30 S1/01 A02

Status and Recent Results of the Double Chooz Neutrino Experiment — •Ilja Bekman for the Double Chooz-Collaboration — III. Physikalisches Institut B, RWTH Aachen University, 52056 Aachen, Germany

The Double Chooz experiment is a reactor neutrino disappearance experiment for the precision measurement of the mixing angle θ_{13}, neutrino oscillation parameter. Located on the nuclear reactor site in Chooz, France, two identical liquid scintillator detectors with baselines of 1050 m and 400 m are installed. These are measuring the flux of the antineutrinos from two reactor cores utilizing the signature of the inverse beta decay (IBD). With the far detector operating since 2011 first indication of the non-zero value of the mixing angle θ_{13} was found, and later refined with utilization of the neutron captures on Hydrogen - additionally to the Gadolinium - in the IBD channel. With the commissioning of the near detector in early 2015 one year of data with both detectors are now available. In this talk the overview of the experiment is given and newest results are presented.

HK 49.3 Do 15:00 S1/01 A02

Removal of stored particle background via the electric dipole method in the KATRIN main spectrometer — •Daniel Hilk for the KATRIN-Collaboration — Institut für Experimentelle Kernphysik, KIT, Karlsruhe

The goal of the KArlsruhe TRItium Neutrino (KATRIN) experiment is to determine the effective mass of the electron anti neutrino by measuring the electron energy spectrum of tritium beta decay near the endpoint. The goal is to reach a sensitivity on the neutrino mass of 200 meV for which a low background level of 10^{-2} counts per second is mandatory. Electrons from single radioactive decays of radon and tritium in the KATRIN main spectrometer with energies in the keV range can be magnetically stored for hours. While cooling down via ionization of residual gas molecules, they produce hundreds of secondary electrons, which can reach the detector and contribute to the background signals. In order to suppress this background component, several methods are investigated to remove stored electrons, such as the application of an electric dipole field and the application of magnetic pulses. This talk introduces the mechanism of background production due to stored electrons and their removal by the electric dipole method in the main spectrometer. In context of the spectrometer- and detector-commissioning phase in summer 2015, measurement results of the application of the electric dipole method are presented. This work was supported by the BMBF under grant no. 05A14VK2 and by the Helmholtz Association.

HK 49.4 Do 15:15 S1/01 A02

Electron spectroscopy measurements with a shifted analyzing plane setting in the KATRIN main spectrometer — •Stephan Dyba for the KATRIN-Collaboration — Institut für Kernphysik, Uni Münster

With the KATRIN (**KA**rlsruhe **TRI**tium **N**eutrino) experiment the endpoint region of the tritium beta decay will be measured to determine the electron-neutrino mass with a sensitivity of 200 meV/c^2 (90% C.L.). For the high precision which is needed to achieve the sub-eV range a MAC-E filter type spectrometer is used to analyze the electron energy.

To understand the various background contributions inside the spectrometer vessel different electric and magnetic field settings were investigated during the last commissioning phase.

This talk will focus on the so called shifted analyzing plane measurement in which the field settings were tuned in a way to provide non standard potential barriers within the spectrometer. The different settings allowed to perform a spectroscopic measurement, determining the energy spectrum of background electrons born within the spectrometer.

This project is supported by BMBF under contract number 05A11PM2.

HK 49.5 Do 15:30 S1/01 A02

Separation and Implantation of the Electron Capture Isotope ^{163}Ho for the ECHo Project — •Fabian Schneider for the ECHo-Collaboration — Institute für Physik und Kernchemie, Johannes Gutenberg-Universität Mainz

The ECHo collaboration aims at measuring the electron neutrino mass by recording the spectrum following electron capture of ^{163}Ho. To reach a sub-eV sensitivity, a large number of individual microcalorimeters is needed, into which the isotope must be implanted in a well controlled manner. The necessary amount of ^{163}Ho is produced by neutron irradiation of enriched ^{162}Er in the ILL high flux reactor. This introduces significant contaminations of other radioisotopes, which have to be quantitatively removed both, by chemical and mass spectrometric separation. The application of resonance ionization at the RISIKO mass separator guarantees the required isotope selectivity for purification and suitable energy for ion implantation. For optimum implantation into the detector pixels ($170 \times 170\ \mu m^2$) with minimum losses, a small ion beam spot at the implantation site is needed. For this purpose, post focusing ion optics were installed and characterized. Furthermore, to reliably provide an ion beam with high ionization efficiency, the temperature distribution of the ion source was optimized based on results of finite-element analysis of the heat flow.

HK 49.6 Do 15:45 S1/01 A02

The Electron Capture in ^{163}Ho experiment — •Clemens Hassel for the ECHo-Collaboration — Kirchhoff-Institute of Physics, Heidelberg University, Germany

The **E**lectron **C**apture ^{163}**Ho** experiment, **ECHo**, has the goal to probe the electron neutrino mass on a sub-eV level via the analysis of the calorimetrically measured **e**lectron **c**apture spectrum (**EC**) of ^{163}Ho.

For this metallic magnetic calorimeters will be used. The performance achieved by a first prototype of MMC with embedded ^{163}Ho already shows that the desired values of an energy resolution of $\Delta E_{FWHM} <$ 3 eV and a signal risetime of $\tau < 1\ \mu s$ for ECHo can be reached.

Recently the energy available for the decay $Q_{EC} = 2833(30_{stat})(15_{sys})$ eV/c^2 has been precisely determind by ECHo. Given this Q_{EC}-value we expect a sensitivity on the electron neutrino mass below 10 eV in the first phase of the ECHo experiment, ECHo-1k. In this phase a high purity ^{163}Ho source with a total activity of 1 kBq will be measured by about 100 detectors operated in a dedicated cryogenic platform in a reduced background environment. The results from this experiment will define parameters to scale the experiment to the next phase ECHo-1M. There the total activity of the source will be 1 MBq and it will be measured by using 10^5 detectors. We present the current status of the ECHo experiment.