T 8: Neutrinophysik I

Zeit: Montag 16:00–18:20 Raum: S06

Gruppenbericht T 8.1 Mo 16:00 S06

Towards a neutrino mass measurement with the KATRIN experiment — •Stephanie Hickford for the KATRIN-Collaboration — Karlsruher Institut für Technologie

The *KArlsruhe TRItium Neutrino* (KATRIN) collaboration aims to determine the neutrino mass with a sensitivity of 0.2 eV/c^2 (90 % CL). This will be achieved by measuring the endpoint region of the tritium β-electron spectrum. High statistics are obtained from a high intensity gaseous tritium source and an $\mathcal{O}(1\ eV)$ energy resolution near the endpoint of molecular tritium at 18575 eV is obtained using a MAC-E filter spectrometer with high angular acceptance.

Two measurement phases took place in 2018, both of which are major milestones on the path to neutrino mass measurements. “First Tritium” took place during May and June, in which trace amounts of tritium at the sub-percent level mixed with deuterium were injected into the source. Commissioning phase III took place during September, in which systematic effects were studied using electrons from a precision photoelectron source and conversion electrons from ^{83m}Kr. The results from these measurement phases, as well as final steps towards neutrino mass measurements beginning in 2019, will be presented in this talk.

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Gruppenbericht T 8.2 Mo 16:20 S06

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

The goal of the Electron Capture in ^{163}Ho (ECHo) experiment is the determination of the electron neutrino mass by the analysis of the electron capture spectrum of ^{163}Ho. The detector technology is based on metallic magnetic calorimeters operated at low temperature in a reduced background environment. During the first phase of the experiment, ECHo-1k, the detector production has been optimised and the implantation process of high purity ^{163}Ho source in large detector arrays has been developed. The implanted detectors have been successfully operated and characterised at low temperatures, reaching energy resolution below 5 eV. High statistics and high resolution ^{163}Ho spectra have been acquired and analysed at the light of the new developed theoretical description of the spectral shape, considering the independently determined value of the energy available to the EC process, Q_{EC}, and a dedicated background model. In this contribution, we present preliminary results obtained in the first phase of ECHo. At the same time we discuss the necessary upgrades towards the second phase of the experiment, ECHo-100k. In particular, we focus on the production of large arrays with ^{163}Ho embedded in the absorbers and on the multiplexed readout.

Gruppenbericht T 8.3 Mo 16:40 S06

The search for eV sterile neutrinos with the STEREO experiment — •Christian Roca, Helena Almazán, Christian Buck, Manfred Lindner, and Stefan Schoppmann — Max-Planck-Institut für Kernphysik Heidelberg

In the last recent years, two unsolved anomalies have appeared during the study of the reactor neutrinos: one related to the neutrino spectral shape, and another to the absolute neutrino flux. The last one, known as the Reactor Antineutrino Anomaly (RAA), presents a deficit in the observed flux compared to the expected one. This anomaly could point to the existence of a light sterile neutrino participating in the oscillation phenomena.

The study of the nuclear reactor flux at very short baselines is a key to prove these hypothesis. The **STEREO** experiment observes neutrinos emitted from the compact, highly ^{235}U enriched fuel element of the research reactor of the Institut Laue Langevin (Grenoble, France). The detector target is placed at only 10 meters of the reactor core, and in order to have an independent measurement of the neutrino spectrum, it is segmented in six independent cells providing a multiple baseline analysis. The recorded data during 113 (138) days of reactor turned on (off) analyzed and presented last year, are compatible with the null oscillation hypothesis and reject the original best-fit of the RAA at 98 % C.L. These results, and the most recent improvements of the second phase of data taking will be presented in this talk, providing a crucial input in the search of sterile neutrinos.

Gruppenbericht T 8.4 Mo 17:00 S06

New Results from the Double Chooz Experiment — •Philipp Soldin for the Double Chooz-Collaboration — III. Physikalisches Institut B, RWTH Aachen University

Double Chooz is a reactor neutrino disappearance experiment that has been operating between 2011 until the end of 2017. Its main purpose has been a precise measurement of the neutrino mixing angle θ_{13}. The experimental setup consisted of two identical liquid scintillator detectors at average baselines of about 400 m and 1 km to two reactor cores at the nuclear power plant in Chooz, France. The neutrinos were detected by measuring the signature of the inverse beta decay (IBD), which consists of a prompt positron- and a delayed neutron capture signal. The double detector setup with an essential iso flux configuration under consideration of all neutrino rates, energy spectral shapes and all relevant backgrounds allows a fit to obtain the neutrino mixing angle θ_{13}. Statistical uncertainties are further reduces by adding the delayed signal of the Hydrogen neutron capture in addition to the Gadolinium, which yields an increase of more than a factor two in statistics. Unique techniques for the selection of antineutrino events and background discrimination and the development of a multivariate, highly parallel fit to the prediction are shown, and the observed spectral distortions are discussed in this talk.

T 8.5 Mo 17:20 S06

Sterile Neutrino Search with the Double Chooz Experiment — •Denise Hellwig, Philipp Soldin, Achim Stahl, and Christopher Wiebusch — III. Physikalisches Institut B, RWTH Aachen

The Double Chooz experiment is a reactor neutrino disappearance experiment located at the Chooz nuclear power plant, France. It measures the electron-antineutrino flux of the two nuclear reactors with two detectors of identical design: A far detector at a distance of about 1 km and a near detector at a distance of about 400 m. The detectors have been operating from 2011 (far) and 2014 (near) till end of 2017. The combination of the two detectors offers sensitivity to sterile neutrino mixing parameters. Sterile neutrinos are neutrino mass states not taking part in weak interactions, but may mix with known neutrino states. This induces additional mixing angles and mass differences where Double Chooz is sensitive to the new mixing angle θ_{14}. This talk describes the search for sterile neutrinos and its results.

T 8.6 Mo 17:35 S06

Analysis of First Tritium Data of the KATRIN Experiment — •Christian Karl for the KATRIN-Collaboration — Max-Planck Institut für Physik

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.) using electrons from tritium β-decay.

First Tritium data was taken in May and June 2018 with the goal of commissioning the full KATRIN system with 1 % nominal activity and demonstrating a global system stability on the 0.1 % level. In addition, this data provides the opportunity to investigate the β-spectrum for systematic effects and test the analysis tools and strategies.

This talk gives an overview of the results from the high-level analysis of First Tritium measurements with a focus on the different analysis strategies as well as a full analysis including systematic effects.

T 8.7 Mo 17:50 S06

Search for the Detection of the Proton Decay $\mathrm{p} \rightarrow \bar{\nu}\mathrm{K}^+$ **in JUNO** — •Konstantin Schweizer and Lothar Oberauer — Technische Universität München, Physik-Department, James-Franck-Str. 1, 85748 Garching

The organic liquid scintillator based JUNO experiment (Jiangmen Underground Neutrino Observatory) has the aim to determine the neutrino mass hierarchy. JUNO can also serve for the search for proton decay due to its large target mass of 20 kton. The decay branch $\mathrm{p} \rightarrow \bar{\nu}\mathrm{K}^+$ is favoured in SUSY models. The K^+ emitted in this decay is invisible in water Cherenkov detectors like SuperKamiokande but can be

observed in JUNO.
We discuss the prospects of JUNO of reaching a high detection efficiency for this specific decay mode and the capability of JUNO to identify background events. Finally, open questions and problems will be addressed.

T 8.8 Mo 18:05 S06

Determining the neutrino mass with Project8: Improving track reconstruction — •Michael Gödel, Christine Claessens, and Sebastian Böser — Johannes Gutenberg Universität Mainz, Institut für Physik, Deutschland

Project 8 aims to measure the absolute neutrino mass scale from the end point distortion of the tritium beta decay spectrum by using Cyclotron Radiation Emission Spectroscopy (CRES). In this approach the electrons are trapped in a magnetic field causing them to emit cyclotron radiation. By recording the frequency of the resulting radio frequency signal in which electrons will appear as lines in a spectrogram, the electron's energy can be reconstructed. The electron signatures can be extracted by applying image processing techniques. In this contribution a short introduction into the experiment is given. A comparison of different event reconstruction methods is presented by taking a look at their characteristic properties and performances.