T 56: Neutrino-Detektoren II

Zeit: Mittwoch 16:00–18:30 Raum: S07

T 56.1 Mi 16:00 S07

Improved approach of monitoring the effective quantum efficiency of Borexino photomultipliers — •Mariia Redchuk[1,2], Zara Bagdasarian[1], Sale-Iti Kroon[1,2], Sindhujha Kumaran[1,2], Livia Ludhova[1,2], and Ömer Penek[1,2] for the Borexino-Collaboration — [1]IKP-2, Forschungszentrum Jülich — [2]III B Physikalisches Institut, RWTH Aachen University

Borexino is a liquid scintillator detector located in Laboratori Nazionali del Gran Sasso in the mountains of central Italy. It is equipped with nominally 2212 inward-facing photomultipliers (PMTs) that are used to detect events producing scintillation light.

The effective quantum efficiency (EQE) represents the amount of incident light detected by the PMT. It may vary in time due to various factors like light yield change or the PMT aging. Therefore, in order to accurately represent the detector in terms of light collection, we need to account for these changes.

We calculate the EQE of each PMT and monitor its changes using the low-energy ^{14}C (Q = 156 keV) events, for which the single-photoelectron mode on each PMT dominates. However, this calculation is sensitive to the position and energy of the selected events as well as to the set of PMTs active in the detector in a given time period. We developed a new more stable method of selecting ^{14}C events and improved the accuracy of the EQE calculation. The highlights of the new approach will be summarized in this talk.

T 56.2 Mi 16:15 S07

Investigation of g_A quenching using the COBRA demonstrator to study the β-spectrum shape of ^{113}Cd — •Stefan Zatschler for the COBRA-Collaboration — TU Dresden, Institut für Kern- und Teilchenphysik

The COBRA experiment is dedicated to the search for the hypothesized neutrinoless double β-decay using CdZnTe semiconductor detectors. Located at the underground facility LNGS in Italy it is shielded from cosmic rays which allows for the investigation of ultra-rare nuclear decays. Besides the examination of naturally present $\beta\beta$-isotopes it also allows for the study of the fourfold forbidden non-unique β-decay of ^{113}Cd.

Nuclear model calculations predict that the spectral shape of the electron momentum distribution of highly forbidden β-decays, such as ^{113}Cd with a Q-value of about 320 keV and a half-life of $8{\cdot}10^{15}$ yrs, is sensitive to the effective value of the axial-vector coupling strength g_A involved in nuclear processes. In order to confirm a quenching of g_A, which is proposed to reproduce half-life measurements with the help of nuclear models, the COBRA demonstrator was optimized for a dedicated ^{113}Cd low-threshold run.

This talk will cover the optimization of the COBRA demonstrator, an overview of the data-taking as well as the statistical analysis to extract effective values of g_A for several considered theory frameworks.

COBRA is funded by the German Research Foundation DFG.

T 56.3 Mi 16:30 S07

α/β discrimination techniques in Borexino — •Sale-Iti Kroon, Zara Bagdasarian, Sindhujha Kumaran, Livia Ludhova, Ömer Penek, Mariia Redchuk, and Yu Xu — Forschungszentrum Jülich, Jülich, Germany

Borexino is a liquid scintillator detector located in the Laboratori Nazionali del Gran Sasso, Italy whose main goal is the measurement of low-energy solar neutrinos. The first complete measurement of all the components of the pp-chain was performed with Borexino detector. In contrast, neutrinos from the CNO fusion cycle, expected to contribute less than 1% to the total solar power, have not been observed yet.

The observation of CNO solar neutrinos even in an ultra-pure liquid scintillator detector is challenging because of the similar spectral shapes of the signal due to CNO neutrinos and the 210Bi background. 210Bi from the 238U chain undergoes β- decay to 210Po and 210Po undergoes α-decay into stable 206Pb. As a part of the 238U decay chain, ideally, 210Bi would be in secular equilibrium with its daughter, 210Po. Unfortunately, due to convective motions inside the detector, 210Po can be introduced into the fiducial volume from peripheral sources. To prevent this, in 2015 the detector has been thermally insulated from its surroundings. Moreover, a large effort is dedicated towards linking the "easy-to-determine" 210Po alpha-decay activity to that of 210Bi. This can be achieved using different alpha/beta discrimination techniques. This study concentrates on testing and evaluation of several pulse-shape variables developed in Borexino analysis.

T 56.4 Mi 16:45 S07

Investigation of detector effects for a sterile neutrino search at KATRIN — •Marc Korzeczek for the KATRIN-Collaboration — Karlsruhe Institut für Technologie, Karlsruhe, Deutschland

The KATRIN (KArsrluhe TRItium Neutrino Experiment) investigates the energy endpoint of the tritium beta-decay to determine the effective mass of the electron anti-neutrino with a precision of 200 meV (@90CL) after an effective data taking time of three years. A possible future extension of KATRIN is the search for a sterile neutrino signature in the tritium beta-decay. Such a search requires measuring the whole energy spectrum of tritium beta-decay and thus requires a redesign of the detector section, as the total rate at the detector is increased by several orders of magnitude. Moreover systematic effects, such as detector backscattering, charge sharing and the detector deadlayer, which lead to drastic modifications of the measured energy spectrum, have to be measured and modeled in order to achieve high sterile neutrino sensitivities. This talk discusses the impact of such systematics and compares measurements to current modeling approaches.

T 56.5 Mi 17:00 S07

Measurement of KATRINs energy loss function using a time of flight method — •Rudolf Sack and Caroline Rodenbeck for the KATRIN-Collaboration — WWU Münster

The **Ka**rlsruhe **Tri**tium **N**eutrino experiment (KATRIN) is a next generation tritium beta decay experiment improving the sensitivity on direct neutrino mass measurements by one order of magnitude over the predecessor experiments. It allows a model independent investigation of the absolute neutrino mass scale with an estimated sensitivity of $0.2\,\mathrm{eV/c^2}$ (90% C.L.)

Understanding energy losses of electrons inside the windowless gaseous tritium source (WGTS) of KATRIN is essential for measuring the tritium beta decay spectrum with the required precision. The electrons can scatter elastically and inelastically off tritium molecules in the WGTS loosing energy in the process and resulting in a modification of the spectrum.

The talk presents a high resolution measurement of the shape of this energy loss function, which was obtained using a time of flight method with monoenergetic electrons from a photoelectron source at the endpoint energy of the tritium beta spectrum of 18.6 keV.

This work is funded by DFG through the Research Training Group 2149 and by BMBF under contract number 05A17PM3.

T 56.6 Mi 17:15 S07

Calibration of the KATRIN high-voltage monitoring system with ^{83m}Kr conversion electrons — •Oliver Rest for the KATRIN-Collaboration — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster

The KATRIN experiment will measure the endpoint region of the tritium-β-decay spectrum to determine the neutrino mass with a sensitivity of 0.2 eV/c^2. To achieve this sub-eV sensitivity the energy of the decay electrons will be analyzed using a MAC-E-filter type spectrometer. The retarding potential of the MAC-E-filter of -18.6 kV has to be monitored with a relative precision of 3 ppm over a measurement period of two month. For this purpose the potential will be measured directly via two custom made ppm-precise high-voltage (HV) dividers. In order to determine the absolute values and the stability of their scale factors, regular calibration measurements with ppm precision are required.

Among other things, the HV will be compared to a natural standard given by mono-energetic conversion electrons from the decay of ^{83m}Kr. This has been done in 2017 with gaseous krypton, which can be injected into the KATRIN source section. With conversion electrons emitted by gaseous ^{83m}Kr not only relative changes but also an absolute calibration of the HV system can be performed, since their kinetic energy is well known. The talk will give an overview of the HV calibration at KATRIN with a gaseous ^{83m}Kr source.

This project is supported by BMBF under contract number 05A14PMA and 05A17PM3.

T 56.7 Mi 17:30 S07

Mechanical Construction and Liquid Handling System of the OSIRIS (Online Scintillator Internal Radioactivity Investigation System) Predetector Facility — •Hans Theodor Josef Steiger[1], Lothar Oberauer[1], Rainer Othegraven[2], Mathias Walter[1], and Michael Wurm[2] for the JUNO-Collaboration — [1]Physik Department der Technischen Universität München, James-Franck Straße 1, 85748 Garching bei München — [2]Institut für Physik, Experimentelle Teilchen und Astroteilchenphysik, Johannes Gutenberg Universität Mainz, Staudinger Weg 7, 55128 Mainz

To ensure the liquid scintillator (LS) quality, necessary for a successful operation of the JUNO (Jiangmen Underground Neutrino Observatory) detector the OSIRIS system is currently designed. This 20 t detector serves as online monitor for the radiopurity of the scintillator produced during the commissioning and production phase of the LS purification plants. After the filling of the JUNO detector detailed studies of the LS characteristics are foreseen. This talk is focused on the mechanical design of the OSIRIS detector and the liquid handling system necessary for the screening of a significant fraction of the 6000l/h of LS produced in the purification plants. This work is supported by the DFG Clusters of Excellence "Universe" and "PRISMA", the DFG Research Unit "JUNO" and the Maier-Leibnitz-Laboratorium.

T 56.8 Mi 17:45 S07

Development of the OSIRIS detector simulation and its sensitivity study — •Christoph Genster[1,2], Yaping Cheng[1,2], Alexandre Göttel[1,2], Livia Ludhova[1,2], Philipp Kampmann[1,2], Michaela Schever[1,2], Achim Stahl[1,2], Yu Xu[1,2], Sebastian Lorenz[3], Paul Hackspacher[3], and Michael Wurm[3] — [1]IKP-2, Forschungszentrum Jülich — [2]III. Physikalisches Institut, RWTH Aachen University — [3]Institute for Physics, Johannes Gutenberg-Universität Mainz

The OSIRIS detector is designed to monitor the radio-purity of the liquid scintillator (LS) during the filling of JUNO detector. It will be located between the LS-purification plant and the JUNO Central Detector and measure the purified LS either in a continuous flow or in batches. Its acrylic vessel can hold 18 tons of LS and it will feature an energy resolution of better than 10% @ 1 MeV. In the filling process of JUNO, OSIRIS will act as an early warning system to prevent contamination of the Central Detector in case of a failure of the purification plant. Beyond this purpose it can further aid JUNO with long-time measurements of the scintillator. This talk will give an overview of the detector simulation and sensitivity studies for OSIRIS.

T 56.9 Mi 18:00 S07

Data reduction and analysis of the ^{163}Ho spectrum for the ECHo experiment — •Clemens Velte[1], Arnulf Barth[1], Martin Brass[3], Sergey Eliseev[4], Loredana Gastaldo[1], Federica Mantegazzini[1], Benjamin Raach[1], Andreas Reifenberger[1], and Alexander Ziegenbein[2] for the ECHo-Collaboration — [1]Kirchhoff Institute for Physics, Heidelberg University — [2]Physikalisches Institut, Tuebingen University — [3]Institute for theoretical physics, Heidelberg University — [4]MPI for Nuclear physics, Heidelberg University

The ECHo experiment has been conceived for the determination of the effective electron neutrino mass. High statistics and high energy resolution spectra will be acquired using large arrays with in total about 10000 metallic magnetic calorimeters with enclosed high purity ^{163}Ho source. The reliability of the high statistics ^{163}Ho spectrum resides in an accurate analysis protocol to be applied to single pixel data sets. This analysis protocol has been first tested for the reduction of acquired data obtained by reading out 24 pixels over 3 weeks. We describe the quality check and calibration each file needs to pass for adding the corresponding data to the final spectrum. This is based on the analysis of key parameters, as energy resolution and background level. Furthermore we present the analysis structure for the high statistics spectrum to extract spectral shape parameters, background contributions, Q_{EC}-value and determine the effective electron neutrino mass evidence. Preliminary results obtained with the analysis of a selected data set will be discussed.

T 56.10 Mi 18:15 S07

Data aquisition systematic effects for sterile neutrino search at KATRIN — •Martin Descher for the KATRIN-Collaboration — Karlsruhe Institut für Technologie, Germany

The KATRIN Experiment (Karlsruhe Tritium Neutrino Experiment) aims to measure the effective electron neutrino mass down to 0.2 eV @90% CL. Using KATRIN's highly active tritium source, it is also possible to search for the signature of a keV sterile neutrino in the differential beta decay spectrum. To reach sensitivity for sterile mixing angles down to $\sin^2\theta = 10^{-6}$, a large statistical sample is necessary. For this, the detector and readout system must be capable of handling extremely high rates of $\approx 10^8$ electron counts per second. The new detector and readout system TRISTAN is designed to live up to this task, but systematic effects from its data aquisition system in respect to high rates still need to be investigated.