T 80: Neutrinophysik IV

Zeit: Donnerstag 16:00–18:20 Raum: S06

Gruppenbericht T 80.1 Do 16:00 S06

The Large Enriched Germanium Experiment for Neutrinoless double beta Decay - Legend — •Christoph Wiesinger for the LEGEND-Collaboration — Physik-Department, Technische Universität München, James-Franck-Straße, 85748 Garching

Isotopically modified high-purity germanium detectors offer unique properties to search for neutrinoless double beta ($0\nu\beta\beta$) decay. The currently operating ^{76}Ge experiments — Gerda and Majorana demonstrator — have achieved the lowest background rate in the signal region. The Large Enriched Germanium Experiment for Neutrinoless double beta Decay (Legend) is building on these experiences. The combination of an ultra-low background environment with active background rejection techniques will allow an almost background-free exploration of $0\nu\beta\beta$ decay half-lives two orders of magnitude beyond our current reach. In the first phase, 200 kg of ^{76}Ge-enriched germanium will be deployed in the existing Gerda infrastructure at the Laboratori Nazionali del Gran Sasso (LNGS) of INFN. The status of this next-generation $0\nu\beta\beta$ decay project will be presented in the talk.

This work has been supported in part by the German Federal Ministry for Education and Research (BMBF) and the German Research Foundation (DFG) via the SFB1258.

T 80.2 Do 16:20 S06

Status of the TRISTAN project — •Thibaut Houdy for the KATRIN-Collaboration — Max Planck Institute for Physics, Föhringer Ring 6, 80805 München, Germany — Technische Universität München, Arcisstraße 21, 80333 München, Germany

The KATRIN (Karlsruhe Tritium Neutrino) experiment investigates the energetic endpoint of the tritium beta-decay spectrum to determine the effective mass of the electron anti-neutrino with a precision of 200 meV (90% C.L.) after an effective data taking time of three years. It had successfully see Tritium light for the first time in June 2018. The TRISTAN (tritium beta-decay to search for sterile neutrinos) group aims at detecting a sterile neutrino signature by measuring the entire tritium beta-decay spectrum with an upgraded KATRIN system. One of the greatest challenges is to handle the high signal rates generated by the strong activity of the KATRIN tritium source while keeping a good energy resolution. Therefore, a novel multi-pixel silicon drift detector is being designed which is able to handle rates up to 100 Mcps with an energy resolution of 200 eV (FWHM) at 10 keV. First seven-pixel prototype detectors were successfully characterized and the first 166 pixels is under production. This talk presents the results of these measurement campaigns as well as next steps toward the final detector.

T 80.3 Do 16:35 S06

Analytical Multivariate Studies in the Borexino Solar Neutrino Analysis — Livia Ludhova[1,2], Simone Marcocci[3], •Ömer Penek[1,2], and Alina Vishneva[4] for the Borexino-Collaboration — [1]IKP-2, Forschungszentrum Jülich — [2]III. Physikalisches Institut, RWTH Aachen University — [3]Gran Sasso Science Institute, L'Aquila — [4]Joint Institute for Nuclear Research, Dubna

The Borexino detector, located at the Laboratori Nazionali del Gran Sasso in Italy, is a liquid scintillator detector with a primary goal to measure solar neutrinos. The spectral fit of the energy spectrum has been performed for the first time in the whole energy range from 0.19 up to 2.93 MeV. To increase the sensitivity for *pep* and CNO neutrinos, the multivariate fit technique has been developed, which takes into account additional information of the radial and pulse shape distributions of events. The talk shows the analytical multivariate fitting strategy used to obtain the new Borexino results for the ^{7}Be, *pp*, and *pep* rates and the sensitivity of the Borexino detector to measure CNO neutrinos. This talk is presented in the name of the Borexino Collaboration.

T 80.4 Do 16:50 S06

Inner vessel shape reconstruction methods of the Borexino experiment — •Vsevolod Orekhov, Johann Martyn, Michael Nieslony, and Michael Wurm for the Borexino-Collaboration — Institute of Physics, JGU Mainz

Borexino is a large liquid-scintillator experiment located deep underground at the Laboratori Nazionali del Gran Sasso in Italy. The unprecedented levels of radio-purity achieved in Borexino enable the experiment to perform solar neutrino spectroscopy with an energy threshold of ∼0.2 MeV. Borexino has been able to measure all spectral components associated with the solar pp-chain. The active core of the detector consists of about 300 t of pseudocumene doped with 1.5 g per litre of PPO and contained in a spherical nylon inner vessel (R = 4.25m). It is very crucial to know the exact vessel shape of the detector in order to estimate the systematic error of the exposure, check position reconstruction tools for events inside the fiducial volume and perform Monte Carlo simulations. Methods based on ^{210}Bi and ^{14}C events are perfectly matched and are in a very good comparison with the vessel shape obtained after photographing it with CCD cameras. Both of them are presented in this talk.

Borexino is supported by funds of the Deutsche Forschungsgemeinschaft (DFG).

T 80.5 Do 17:05 S06

The OSIRIS pre-detector - A radioactivity monitor for the JUNO liquid scintillator — •Paul Christian Hackspacher and Michael Wurm for the JUNO-Collaboration — Johannes Gutenberg-Universität Mainz

The Jiangmen Underground Neutrino Observatory (JUNO) is a 20 kt liquid scintillator reactor neutrino experiment currently being built in the Guangdong province in southern China. In order to reliably reconstruct neutrino-induced inverse beta decay events from photomultiplier signals, scintillator purity is imperative. Potential air leaks in the filling and cycling lines or failures of the purification plants are risks that endanger the high radiopurity necessary to obtain clean signals within such a large active target volume. The Online Scintillator Internal Radioactivity Investigation System (OSIRIS) is being developed as a failsafe monitor to assess the quality of the scintillator batches before filling them into the central detector. This presentation will serve as a general introduction to the project concept, design and schedule, with more details on software and hardware shown in their own respective talks. This work is supported by the DFG Research Unit "JUNO".

T 80.6 Do 17:20 S06

Background reduction in the ECHo experiment — •Alexander Göggelmann for the ECHo-Collaboration — Kepler Center for Astro and Particle Physics, Universität Tübingen

The ECHo experiment is designed to determine the effective ν_e-mass by analyzing the endpoint region of the calorimetrically measured ^{163}Ho electron capture spectrum.

To reach sub-eV sensitivity on the effective electron neutrino mass the identification and reduction of background is extremely important.

We consider three main contributions to the background in the ^{163}Ho spectrum: Intrinsic background due to unresolved pile-up events, events due to radioactive contamination in the detector and detector set-up and events induced by cosmic radiation.

In this contribution we present the strategies developed by the ECHo collaboration in order to reduce the background in the experiment.

In particular we discuss the use of an active muon veto which is installed around the ECHo cryostat to discriminate muon induced events. In conclusion, we will report on the contribution of muon induced and natural radioactivity background.

T 80.7 Do 17:35 S06

Measurement of low energy electron capture spectra to test the impact of high order processes — •Tobias Schmitt[1], Christian Enss[1], Andreas Fleischmann[1], Loredana Gastaldo[1], Sebastian Kempf[1], Ulli Koester[2], Federica Mantegazzini[1], and Clemens Velte[1] for the ECHo-Collaboration — [1]Kirchhoff Institute for Physics, Heidelberg University. — [2]Institut Laue-Langevin, Grenoble.

The neutrino mass can be determined by analyzing the shape of the endpoint region of electron capture spectra. The best candidate for this investigation is ^{163}Ho due to its low Q-value. Recent measurements of high statistic ^{163}Ho spectra, performed by the ECHo collaboration, showed, that available theories can not describe the spectral shape. The deviations are in the order of 5 percent of the total spectrum.
The best description of the ^{163}Ho spectrum is nowadays obtained using methods developed for the calculation of core level spectroscopy.

To be able to better understand the excitations in which a ^{163}Dy atom can be left after an EC-process occurred in ^{163}Ho, we decided to study the calorimetrically measured EC spectrum of ^{193}Pt. With its relatively low Q-value of 56 keV and the large atomic number it shares two important properties with ^{163}Ho. The analysis of the ^{193}Pt spectrum will allow for testing theories developed for the description of the ^{163}Ho spectrum both in the same energy range as well as for captures from the second shell. We will give a status report on the detector design, ^{193}Pt enclosure and the completed experimental platform we developed with the goal to measure a ^{193}Pt electron capture spectrum.

T 80.8 Do 17:50 S06

Time-Focusing-Time-of-Flight methods for neutrino mass measurements at KATRIN — •Alexander Fulst for the KATRIN-Collaboration — Institut für Kernphysik, WWU Münster

The KArlsruhe TRItium Neutrino (KATRIN) experiment aims at a direct and model independent determination of the electron antineutrino mass with a sensitivity of $0.2\,\mathrm{eV}/c^2$.

In its design configuration the statistical sensitivity of KATRIN will reach $\sigma_{\mathrm{stat}}(m^2_{\nu_e}) = 0.018\,\mathrm{eV}^2/c^4$ after 3 years of measurement time. Investigations have shown that the sensitivity can be improved by up to a factor of 5 in the ideal case using Time-of-Flight (ToF) methods. This improvement is possible because the flight time of an electron depends on its kinetic energy, enabling the measurement of a differential spectrum compared to the integrated spectrum measured by a MAC-E filter in standard mode. However, this requires a well known start time of the electrons, which is not easy to acquire. Here, a different method is presented, were electrons are accelerated depending on their arrival time at a dedicated Time-Focusing-Time-of-Flight section. The TFTOF concept is introduced and results of an extended Monte-Carlo study are presented.

This work is supported under BMBF contract number 05A17PM3.

T 80.9 Do 18:05 S06

Reduction of the ^{14}C background in the JUNO experiment — •Philipp Kampmann[1,2], Yaping Cheng[1], Christoph Genster[1,2], Alexandre Göttel[1,2], Livia Ludhova[1,2], Michaela Schever[1,2], Achim Stahl[2], Christopher Wiebusch[2], and Yu Xu[1,2] — [1]IKP-2, Forschungszentrum Jülich — [2]III Physikalisches Institut, RWTH Aachen University

The Jiangmen Underground Neutrino Observatory (JUNO) will be a 20 kt liquid scintillator neutrino detector. Its main goal is the determination of the neutrino mass hierarchy from a precise measurement of the energy spectrum of anti-electron-neutrinos 53 km away from the emitting nuclear reactor cores. To precisely measure the oscillation pattern of the reactor spectrum an unpredecent energy resolution for this kind of detector of 3% at 1 MeV is needed. Pile-up events with background from radioactive decays such as those from ^{14}C can spoil the reconstruction of the neutrino energy. In this talk methods for discriminating pile-up events are presented. These methods are in addition to a simple clusterization algorithm, the utilization of spherical harmonics and a Likelihood-test of the photon hit time informations.