T 92: Neutrinophysik IV

Zeit: Donnerstag 16:30–18:40 Raum: Z6 - SR 2.012

Gruppenbericht T 92.1 Do 16:30 Z6 - SR 2.012

Results on the search for neutrinoless double beta decay from GERDA Phase II — •Anna Julia Zsigmond for the GERDA-Collaboration — Max-Planck-Institut für Physik

The Gerda (GErmanium Detector Array) experiment, located at the Laboratori Nazionali del Gran Sasso, is searching for the lepton number violating neutrinoless double beta ($0\nu\beta\beta$) decay of ^{76}Ge. Since the end of 2015, in Phase II of the experiment, 35 kg of enriched high-purity germanium detectors are operated in liquid argon (LAr), that serves as cooling medium for the detectors as well as active shield against external radiation. The aim is to reach a sensitivity on the $0\nu\beta\beta$ decay half-life larger than 10^{26} yr. This is possible with a background level of 10^{-3} cts/(keV·kg·yr) and an exposure of about 100 kg·yr. The background level has been achieved by using the scintillation light of the LAr for background rejection and by using BEGe type detectors with superior pulse shape discrimination properties. In this talk the details of the analysis and the latest half-life limit of the $0\nu\beta\beta$ decay search will be presented.

T 92.2 Do 16:50 Z6 - SR 2.012

Understanding Pulse Shape Discrimination in Germanium Detectors: Diffusion Effects — •Barbara Schweisshelm for the GERDA-Collaboration — Max-Planck-Institut für Physik, München

The Gerda experiment is searching for neutrinoless double beta ($0\nu\beta\beta$) decay in ^{76}Ge using high purity Germanium detectors. To reach sensitivities for the $0\nu\beta\beta$ decay half-life of $>10^{26}$ years the energy region of interest needs to be background free during the run time of the experiment. A crucial requirement to assure this is an excellent discrimination of signal and background like events. For this purpose pulse shape discrimination of the germanium detector signals is utilized. In the case of BEGe type detectors the ratio of the maximum amplitude of the current pulse and the energy, A/E, is used to distinguish between signal and background like events. In order to achieve a better understanding on how the A/E parameter depends on energy, simulations of the signal pulses have been performed. The simulations of charge carrier behavior make it possible to study the effects of charge diffusion, self-repulsion, and the initial charge cloud size on A/E. In this talk the implementation of the diffusion effects in the simulation will be summarized and their influence on the discrimination parameter will be discussed.

T 92.3 Do 17:05 Z6 - SR 2.012

Investigation of the double beta decay of Ge-76 into excited states of Se-76 with Gerda — •Birgit Schneider and Thomas Wester for the GERDA-Collaboration — TU Dresden, Institut für Kern- und Teilchenphysik, Germany

Gerda is an experiment searching for the neutrinoless double beta ($0\nu\beta\beta$) decay of ^{76}Ge. The observation of such a decay would prove that the neutrino is its own antiparticle, a so called Majorana particle. This could give an indication of the effective Majorana neutrino mass and of the mass hierarchy realized in nature.

The neutrino accompanied double beta ($2\nu\beta\beta$) decay from the 0^+ ground state of ^{76}Ge into the 0^+ ground state of ^{76}Se has been measured by Gerda and its half life could be determined with unprecedented precision. Additionally, ^{76}Ge can also decay into excited states of ^{76}Se, however these transitions are phase space suppressed. The predicted half lives from theoretical calculations vary by several orders of magnitude, because of different nuclear models and their internal parameters. The observation of the $2\nu\beta\beta$ decay of ^{76}Ge into excited states would be able to constrain these models and decrease their uncertainties. Additionally, models of the $0\nu\beta\beta$ decay, that rely on similar assumptions, would be improved.

The excited states analysis of the Gerda data is performed by counting coincident events within the Ge detector array and optimized with the help of Monte Carlo simulations. The talk will present the analysis technique and the first preliminary results of Gerda Phase II.

This project is partially funded by BMBF.

T 92.4 Do 17:20 Z6 - SR 2.012

The cosmic muon induced background in Gerda and its implications for Legend — •Christoph Wiesinger[1], Luciano Pandola[2], and Stefan Schönert[1] — [1]Physik-Department and Excellence Cluster Universe, Technische Universität München, Garching, Germany — [2]INFN Laboratori Nazionali del Sud, Catania, Italy

In-situ production of long-lived isotopes by cosmic muon interactions may generate a non-negligible background for deep underground rare event searches. Previous Monte Carlo studies identified the delayed decay of $^{77(m)}$Ge as dominant cosmogenic background in the search for neutrinoless double beta decay of ^{76}Ge. This might limit the sensitivity of next generation experiments and thereby define a minimum depth requirement. A re-evaluation of the $^{77(m)}$Ge background for the Gerda (GERmanium Detector Array) experiment at Lngs (Laboratori Nazionali del Gran Sasso) has been carried out by a set of Monte Carlo simulations. State-of-the art active background suppression and simple delayed coincidence cuts lead to a background contribution of $(2.7\pm0.3)\cdot10^{-6}$ cts/(keV·kg·yr) at a reasonable life-time loss of $< 4\%$. Exploiting this active suppression strategy opens the way for next generation rare event searches with Legend (Large Enriched Germanium Experiment for Neutrinoless $\beta\beta$ Decay) at Lngs. This work has been supported by the German Federal Ministry for Education and Research (BMBF) Verbundforschung 05A17W02 and the German Research Foundation (DFG) via the SFB1258.

T 92.5 Do 17:35 Z6 - SR 2.012

Light Detectors Development and Characterization for Cupid $0\nu\beta\beta$ Decay Experiment — •Maria Teresa Barrera Rojas for the CUPID-0-Collaboration — INFN Laboratori Nazionali di Legnaro, Legnaro, Italy

The CUORE Upgrade project CUPID (Cryogenic Underground Observatory for Rare Events Upgrade with Particle IDentification) scientific goal is to explore the inverted hierarchy of neutrino masses and search for the violation of the lepton number due to $0\nu\beta\beta$ decay. One of its R&D lines of the CUPID project combines semiconducting light detectors and $Zn^{82}Se$ bolometric-scintillator crystals to simultaneously detect the light emitted by an event in the bolometer itself, allowing the discrimination of α particles from γ/e.

Identification of the natural induced radioactivity (mostly α) allows to reach the zero-background operation conditions. One of the main challenges is the small amount of light transmitted to the detector, but it can be enhanced by incorporating anti-reflective coatings. This talk will discuss the status of the experiment, the optimization of the light transmittance and optical characterization of the detectors.

Gruppenbericht T 92.6 Do 17:50 Z6 - SR 2.012

The Stereo Experiment: the Search for eV Sterile Neutrinos — •Helena Almazán, Christian Buck, Julia Haser, Manfred Lindner, Christian Roca, and Stefan Schoppmann — Max-Planck-Institut für Kernphysik (Heidelberg)

Nuclear reactors are an intense and pure source of low energy electron antineutrinos. In combination with other sources, they have been used to discover and understand neutrino oscillations. However, 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 latter, known as the Reactor Antineutrino Anomaly, presents a deficit in the observed flux compared to the expected at very short baselines (distance < 100 meters). This anomaly could point to the existence of a light sterile neutrino participating in the oscillation phenomena, and a way to prove it is the study of the reactor neutrino flux at very short baselines.

The Stereo experiment, taking data since November 2016, is trying to resolve this anomaly. It is placed at 10 meters from the compact, highly enriched ^{235}U fuel element of the research reactor of the Institut Laue Langevin (Grenoble, France). The detector target is segmented in six cells providing a multiple baselines analysis. Oscillations to a sterile neutrino in the eV mass scale can be identified by characteristic distortions in the neutrino energy spectrum of the different cells.

The most recent results of this experiment are going to be presented in this talk.

T 92.7 Do 18:10 Z6 - SR 2.012

Calibration of the Stereo Experiment — •Christian Roca, Helena Almazán, Christian Buck, Julia Haser, Manfred Lindner, and Stefan Schoppmann — Max-Planck-Institut für Kernphysik

The Stereo experiment, running since November 2016 at the ILL

Grenoble, aims to test the hypothesis of sterile neutrinos being the cause of the reactor antineutrino anomaly observed at short baselines. The detector is divided in two main volumes each filled with liquid scintillator. The inner volume is segmented in six independent cells corresponding to the neutrino target (TG). It is doped with gadolinium to enhance the detection of the correlated signal produced by the inverse beta decay. Surrounding the TG there is the gamma catcher (GC) volume, optimized to capture escaping gammas originating from interactions in the TG. The energy deposited in the detector is measured as scintillation light that is collected by a set of photomultiplier tubes. The readout charge signals are converted to visible energy by a dedicated non-linear energy scale. To determine the energy scale, detection efficiency and to observe the detector stability, several gamma and neutron sources have been deployed by means of three different calibration systems: an internal set of tubes located within the TG cells, a central rail underneath the detector crossing the TG and GC volume, and an outer pantograph-rail system for 2d calibration around the GC. The calibration runs performed during the phases I and II of Stereo and their use on the energy scale and detection efficiency determination are discussed in this talk.

T 92.8 Do 18:25 Z6 - SR 2.012

Cryogenic Platform and readout for the ECHo experiment
— •Dorothea Fonnesu for the ECHo-Collaboration — Kirchhoff-Institut fuer Physik, Universitaet Heidelberg

The ECHo experiment is designed to investigate electron neutrino mass below 1 eV/c^2 by analyzing the endpoint region of the calorimetrically measured ^{163}Ho electron capture spectrum. Large arrays of low temperature metallic magnetic calorimeters with ^{163}Ho enclosed in the particle absorber are used in ECHo. These detectors are operated well below 100 mK. To run the first phases of ECHo, a costumized dilution refrigerator has been equipped with cable for parallel and multiplexed readout.In this talk the commissioning of the cryogenic platform will be discussed with particular emphasis to the cabling concepts.

For the first phase of the ECHo experiment ECHO-1k, a 64-pixel parallel readout scheme has been optimized for the first measurement of high statistics spectra. We describe the design of the modules to host the chip with the detector array and the front-end SQUIDs as well as of the modules for SQUID-array amplification stage. Finally, we present the performance achieved in first characterization runs for the ECHo-1k experiment.