T 16: Neutrinoloser Doppelbeta-Zerfall I

Zeit: Montag 11:00–12:35 Raum: VMP9 SR 07

Gruppenbericht T 16.1 Mo 11:00 VMP9 SR 07

The COBRA Experiment - Status and Prospects — •Stefan Zatschler for the COBRA-Collaboration — TU Dresden, Institut für Kern- und Teilchenphysik, Germany

COBRA is a next-generation experiment dedicated to the search for the existence of neutrinoless double beta-decay ($0\nu\beta\beta$-decay). The aim is to clarify the nature of neutrinos as either Dirac or Majorana particles. Furthermore, the study of $0\nu\beta\beta$-decay could allow for the identification of the neutrino mass hierarchy realized in nature and the determination of the effective Majorana neutrino mass in case of a signal.

Currently a demonstrator setup at the underground facility LNGS (Italy) built of 4×4×4 coplanar grid (CPG) detectors collects high quality low background physics data with FADC pulse shape sampling. The detectors are made of natural abundant CdZnTe, which is a commercially available room temperature semiconductor. It contains several double beta isotopes, the most promising of which is ^{116}Cd with a Q-value of 2813.5 keV – which is well above the highest naturally occurring γ-lines.

In this talk an overview of the experimental status and recent results of the data analysis of the LNGS detector array will be presented. Additionally, newly developed techniques to reduce background via pulse shape analysis and future prospects towards a large-scale setup will be discussed.

The COBRA experiment is funded by the German Research Foundation DFG.

T 16.2 Mo 11:20 VMP9 SR 07

In-situ measurement of the light attenuation in liquid argon in the GERDA cryostat — •Birgit Schneider for the GERDA-Collaboration — TU Dresden, Institut für Kern- und Teilchenphysik, Germany

GERDA is an experiment searching for neutrinoless double beta decay in ^{76}Ge. It operates the enriched germanium detectors bare in liquid argon (LAr), which serves both as a coolant and a shield for external radiation. Phase II of GERDA aims for an exposure of 100 kg · yr with a background index (BI) of 10^{-3} cts/(kg · yr · keV). One of the major improvements to further reduce the BI comes from the instrumentation of the LAr to readout its scintillation light. The attenuation of the scintillation light in LAr limits the effective active volume of the LAr veto and is therefore a key parameter to characterize the instrumentation.

In order to measure the light attenuation in LAr, a setup was designed that could be deployed directly into the GERDA cryostat. This setup contains a movable beta source and a PMT to detect the scintillation light at different distances.

The talk will present the acquired data as well as a detailed description of the performed analysis technique and the current results.

This project is partially funded by BMBF.

T 16.3 Mo 11:35 VMP9 SR 07

Results of a search for neutrinoless double-beta decay using the COBRA demonstrator — •Thomas Quante, Claus Gössling, and Kevin Kröninger — TU Dortmund, Exp. Physik IV, Dortmund

COBRA is an experiment aiming to search for neutrinoless double-beta-decay ($0\nu\beta\beta$-decay) using CdZnTe semiconductor detectors. The main focus is on ^{116}Cd, with a Q-value of 2813.5 keV well above the highest dominant naturally occurring gamma lines. By measuring the half-life of the $0\nu\beta\beta$-decay, it is possible to clarify the nature of the neutrino as either Dirac or Majorana particle and furthermore to determine its effective Majorana mass.

The COBRA collaboration operates a demonstrator to search for these decays at the Laboratori Nazionali del Gran Sasso in Italy. The exposure of 234.7 kg d considered in this analysis was collected between September 2011 and February 2015. The analysis focuses on the decay of the nuclides ^{114}Cd, ^{128}Te, ^{70}Zn, ^{130}Te and ^{116}Cd. A Bayesian analysis is performed to estimate the signal strength of $0\nu\beta\beta$-decay.

T 16.4 Mo 11:50 VMP9 SR 07

Study of pulse shapes in Ge detectors with PET — Peter Grabmayr, Alexander Hegai, Josef Jochum, Christopher Schmitt, and •Ann-Kathrin Schütz for the GERDA-Collaboration — Eberhard Karls Univerität Tübingen

The Gerda collaboration aims to determine the half life of the neutrinoless double beta decay ($0\nu\beta\beta$) of ^{76}Ge. For Phase II Gerda wants to reduce the background contribution significantly by active background-suppression techniques. One of such techniques is the pulse shape analysis of signals induced by the interaction of radiation with the detector. The pulse shapes depend not only on the energy of the interacting gamma, the geometry and field configuration but also on the location of interaction in the crystal. The waveform and the location of the interaction in the germanium can be determined by positron-emission-tomography (PET). First results of this novel pulse shape study with the PET will be presented in this talk. This work was partly funded by the BMBF.

T 16.5 Mo 12:05 VMP9 SR 07

Performance of the LAr scintillation veto of Gerda Phase II — •Christoph Wiesinger for the GERDA-Collaboration — Physik-Department and Excellence Cluster Universe, Technische Universität München, James-Franck-Straße, 85748 Garching

Gerda is an experiment to search for the neutrinoless double beta decay in ^{76}Ge. Results of Phase I have been published in summer 2013 and Gerda has been upgraded to Phase II. To reach the aspired background index of $\sim 10^{-3}$ cts/(keV·kg·yr) for Phase II active background-suppression techniques are applied, including an active liquid argon (LAr) veto. It has been demonstrated with the LArGe test facility that the detection of argon scintillation light can be used to effectively suppress background events in the germanium detectors, which simultaneously deposit energy in the LAr. The light instrumentation consisting of photomuliplier tubes (PMT) and wavelength-shifting fibers connected to silicon photomultipliers (SiPM) has been installed in Gerda. In this talk the low background design of the LAr veto and its performance during Phase II start-up will be reported.

This work was partly funded by BMBF.

T 16.6 Mo 12:20 VMP9 SR 07

Das Minidex-Experiment zur Vermessung Myonen-induzierter Neutronen — •Raphael Kneissl für die GERDA-Kollaboration — MPI für Physik, München, Deutschland

Die Beobachtung sehr seltener Prozesse, wie z.B des neutrinolosen Doppelbetazerfalls, erfordert extrem strahlungsarme Umgebungen und Detektoren. Um die nötige Sensitivität zu erreichen, ist es wichtig, die noch vorhandenen Strahlungsuntergründe zu unterdrücken sowie diese zu verstehen. Einer dieser Untergründe sind Myon-induzierte Neutronen, die außerhalb im Gestein oder direkt in den Abschirmungsmaterialien des Experiments erzeugt werden. Des Weiteren können in den Detektoren durch Myon-induzierte Neutronen beim Transport oder der Lagerung radioaktive Isotope entstehen. Die Neutronenproduktionsraten durch Myonen in verschiedenen Materialien sind nicht genau vermessen. Um genauere Vorhersagen darüber machen zu können, welcher Untergrundbeitrag in zukünftigen Experimenten erwartet wird, wurde der Minidex (Muon induced neutron indirect detection experiment) Aufbau im Tübinger Untergrundlabor errichtet. Mit diesem Aufbau können Neutronen, die im untersuchten Material durch Myonen induziert wurden, nachgewiesen werden. Dies geschieht mit HPGe Detektoren, die den thermischen Einfang von Neutronen an Wasserstoffatomen nachweisen. Es sollen Neutronenproduktionsraten in verschiedenen Abschirmmaterialien untersucht werden. Im Vortrag werden der Aufbau, die Datenanalyse sowie die Resultate des Minidex-Experiments vorgestellt.