HK 15: Astroteilchenphysik

Zeit: Montag 16:30–19:00 Raum: HZ 9

Gruppenbericht HK 15.1 Mo 16:30 HZ 9

A liquid argon scintillation veto for the Gerda experiment — •Anne Wegmann for the GERDA-Collaboration — Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg

Gerda is an experiment to search for the neutrinoless double beta decay of ^{76}Ge. Results of Phase I have been published in summer 2013. Currently Gerda is being upgraded to a second phase. To reach the aspired background index of $\leqslant 10^{-3}$ cts/(keV·kg·yr) for Phase II active background-suppression techniques will be applied, including an active liquid argon veto (LAr veto).

It has been demonstrated by the LArGe test facility that the detection of argon scintillation light can be used to effectively suppress background events in the germanium, which simultaneously deposit energy in LAr.

This talk focusses on the light instrumentation which is being installed in GERDA. Photomultiplier tubes (PMT) and wavelength-shifting fibers connected to silicon photomultipliers (SiPM) are combined to maximize the photoelectron-yield with respect to various background sources. Monte Carlo simulations have been performed to optimize the design for background suppression and low self-induced background. First results of the prototypes and the progress of installation are reported.

Gruppenbericht HK 15.2 Mo 17:00 HZ 9

GERDA and the search for neutrinoless double beta decay: first results and perspectives — •Matteo Agostini for the GERDA-Collaboration — Physik Department and Excellence Cluster Universe, Technische Universität München, Germany

Neutrinoless double beta decay is a lepton-number-violating nuclear transition predicted by several extensions of the Standard Model. The Gerda experiment searches for this transition in ^{76}Ge by operating bare Ge detectors in liquid Ar. The talk focuses on the results of data acquired during Phase I of the experiment, in which 21.6 kg·yr of exposure were accumulated with a background index of about 0.01 cts/(keV·kg·yr). No signal was observed and a lower limit was derived for the half-life of neutrinoless double beta decay of ^{76}Ge, $T_{1/2} > 2.1 \cdot 10^{25}$ yr (90% C.L.). The experiment is currently undergoing a major upgrade in preparation for the next phase of data taking. Thanks to an increased target mass, an improved energy resolution and the introduction of novel background reduction techniques, the sensitivity of Gerda will increase of about one order of magnitude in a few years of operation.

Gruppenbericht HK 15.3 Mo 17:30 HZ 9

Background reduction at low energies with BEGe detector operated in liquid argon using the Gerda-LArGe facility — •Dušan Budjáš for the GERDA-Collaboration — Physik-Department E15, Technische Universität München, Germany

LArGe is a low background test facility used for proving innovative approaches to background reduction in support of the neutrinoless double beta decay experiment Gerda. These approaches include an anti-Compton veto using scintillation light detection from liquid argon, as well as a novel pulse shape discrimination method exploiting the characteristic electrical field distribution inside BEGe detectors. The latter technique can identify single-site events (typical for double beta decays) and efficiently reject multi-site events (typical for backgrounds from gamma-ray interactions), as well as different types of background events from detector surfaces.

While the main focus of the LArGe facility is to assist with reaching the goal of Gerda – improving the sensitivity for ^{76}Ge neutrinoless double beta decay search, reducing the background at low energies and lowering the energy threshold is also of interest. In particular such efforts can be potentially relevant for search of dark matter or low energy neutrino interactions. In this talk I will present the experimental measurement of the low energy region with a BEGe detector operated in LArGe with the application of powerful background suppression methods. The performance will be compared to that of some dedicated dark matter detection experiments.

HK 15.4 Mo 18:00 HZ 9

BEGe detectors in GERDA Phase I - performance, physics analysis and surface events — •Andrea Lazzaro for the GERDA-Collaboration — Physik-Department E15, Technische Universität München, Germany

The Phase I of the Gerda experiment, which has concluded its data taking in Summer 2013, was based on coaxial HPGe detectors already used for IGEX and HdM experiments. In the upcoming Phase II customized Broad Energy Germanium (BEGe) detectors will provide the major contribution to the total exposure. The first set of BEGe detectors has been deployed in Gerda since June 2012.

The data collected in Phase I show the performance achieved in terms of spectroscopy and pulse shape discrimination. In particular the strongest background source, the ^{42}K beta decay from the liquid argon surrounding the detectors, has been effectively rejected. The signals due to beta decay on the detector surface are indeed characterized by a longer charge collection time. This talk will focus on this key feature of the BEGe-PSD.

This work was supported in part by BMBF (05A11W01).

HK 15.5 Mo 18:15 HZ 9

Test of GERDA Phase II Detector Assembly — Tobias Bode[1], Konstantin Gusev[1], Bernhard Schwingenheuer[2], and •Victoria Wagner[2] for the GERDA-Collaboration — [1]Technische Universität München — [2]Max-Planck Institut für Kernphysik, Heidelberg

The GERDA experiment searches for the lepton number violating neutrinoless double beta decay ($0\nu\beta\beta$) of ^{76}Ge. The experiment uses HPGe detectors enriched in ^{76}Ge as source and detection material. In GERDA Phase I five BEGe detectors were operated successfully. These detectors are distinguished for improved energy resolution and enhanced pulse shape discrimination (PSD) against background events. In Phase II additional 25 BEGe detectors will be installed. New electronics and radio-pure low-mass holders were specially designed for Phase II. Prior to the installation in GERDA all BEGe detectors are tested in their final assembly in the LNGS underground laboratory. This talk will present the mechanics and performance of the GERDA Phase II detector assembly.

HK 15.6 Mo 18:30 HZ 9

Scintillating $CaWO_4$ Crystals for the CRESST-II and EURECA Dark Matter Searches — •Moritz v. Sivers[1], Andreas Erb[2], Andreas Ertl[1], Achim Gütlein[1], Jean-Côme Lanfranchi[1], Andrea Münster[1], Felix Neumann[1], Walter Potzel[1], Sabine Roth[1], Stefan Schönert[1], Raimund Strauss[3], Stephan Wawozcny[1], Michael Willers[1], Marc Wüstrich[3], and Andreas Zöller[1] — [1]Physik Department, E15, Technische Universität München, 85748 Garching — [2]Walther-Meissner-Institut für Tieftemperatur Forschung, 85748 Garching — [3]Max-Planck-Institut für Physik, 80805 München

The CRESST-II experiment for the direct detection of WIMP dark matter uses scintillating $CaWO_4$ crystals that are operated as low-temperature detectors. EURECA is a joint collaboration of existing cryogenic direct dark matter searches to develop a future multi-material experiment with a target mass of up to one ton. While in the past crystals were obtained from external suppliers, we recently started producing $CaWO_4$ single crystals with a dedicated Czochralski furnace at the Technische Universität München to have a direct influence on the radiopurity and scintillation properties. We present here an overview of the growth process as well as measurements of the crystals' scintillation properties and radiopurity. This research was supported by the DFG cluster of excellence: "Origin and Structure of the Universe", the "Helmholtz Alliance for Astroparticle Phyiscs", the "Maier-Leibnitz-Laboratorium" (Garching) and by the BMBF: Project 05A11WOC EURECA-XENON.

HK 15.7 Mo 18:45 HZ 9

Ladungstransport in Germaniumdetektoren des EDELWEISS-III Experiments — •Nadine Foerster für die EDELWEISS-Kollaboration — Karlsruher Institut für Technologie, Institut für Experimentelle Kernphysik, Postfach 3640, 76021 Karlsruhe

Ziel des EDELWEISS-III Experiments zur direkten Suche nach Dunkler Materie ist die Detektion von WIMPs unter Verwendung kryogener Germanium-Bolometer. Ein System aus Elektroden erzeugt im Inneren der Germaniumkristalle ein homogenes elektrisches Feld.

Durch gleichzeitige Messung des durch eine Streureaktion verursachten Wärmeanstiegs und der erzeugten Elektronen-Loch Paare als Ionisierungssignal an den Elektroden ist eine Identifizierung von Ge-Kernrückstößen möglich. Um eine effiziente Diskriminierung zwischen Hintergrundereignissen und WIMP Kanidaten zu erhalten, ist eine möglichst vollständige Detektion aller erzeugten Ladungsträger entscheidend. In diesem Vortrag wird ein Überblick über die Modellierung des Ladungstransports in Germanium bei tiefen Temperaturen (20 mK) und niedrigen externen Feldstärken ($< 10\,\mathrm{V/cm}$) gegeben. Resultate von Spezialmessungen mit einem Testdetektor, der den selben Herstellungsprozess durchlaufen hat wie die EDELWEISS-III Detektoren, werden vorgestellt.

Die hier präsentierten Analysen werden gefördert durch die DFG Graduiertenschule KSETA (Karlsruher Schule für Elementarteilchen und Astroteilchenphysik: Wissenschaft und Technik).