HK 40: Astroteilchenphysik

Zeit: Donnerstag 16:30–18:45 Raum: RW 3

Gruppenbericht HK 40.1 Do 16:30 RW 3

A nuclear physics view at the ^{71}Ga$(\nu, e^-)^{71}$Ge reaction. — •Annika Lennarz[1], Dieter Frekers[1], Peter Puppe[1], Jan Thies[1], and Michael Holl[2] — [1]Inst. f. Kernphysik, 48149 Münster — [2]Inst. f. Theor. Physik, 48149 Münster

In this contribution we will present results from two separate experiments dealing with the neutrino response on ^{71}Ga. Both experiments provide input into the calibration of the SAGE and GALLEX solar neutrino detectors and address a long-standing discrepancy between the measured and evaluated capture rates from the ^{51}Cr and ^{37}Ar neutrino calibration sources. First, we report on a ^{71}Ga(^{3}He,t)^{71}Ge charge-exchange experiment performed at RCNP, Osaka, with the objective to extract with high precision the Gamow-Teller transition strengths to the three lowest-lying states in ^{71}Ge, i.e., the ground state ($1/2^-$), the 175 keV ($5/2^-$) and the 500 keV ($3/2^-$) excited states. These are the states, which are populated via a charged-current reaction induced by neutrinos from terrestrial ^{51}Cr and ^{37}Ar sources. In the second part we present a new precision Q-value measurement for the ^{71}Ga$(\nu, e^-)^{71}$Ge reaction using the TITAN mass measurement facility at TRIUMF. From the results of the two experiments we may now conclude that there are no further unknowns in the nuclear structure, which could remove the persistent discrepancy in the SAGE and GALLEX calibration measurement performed with neutrinos from ^{51}Cr and ^{37}Ar sources.

Gruppenbericht HK 40.2 Do 17:00 RW 3

The GERDA experiment on the 0nbb decay — •Fabiana Cossavella for the GERDA-Collaboration — Max-Plank-Institut für Physik, München

The Germanium Detector Array (GERDA) experiment searches for neutrinoless double beta decay of ^{76}Ge, a test of whether neutrinos are identical with their anti-particles, i.e. of Majorana type, or distinct from them, i.e. of Dirac type. Neutrinoless double beta decay could not only establish the charge-conjugation character of neutrinos, but also place a limit on the effective neutrino mass and probe the neutrino mass hierarchy.

Germanium crystals enriched in ^{76}Ge, acting as source and detector, will be submerged in an ultra-pure cryogenic liquid that serves as cooling medium and shields against radiation. This allows for a background reduction of up to two orders of magnitude better than earlier experiments.

GERDA started the technical runs in 2010, with a pilot string of 3 non-enriched Ge detector. In 2011 measurements with enriched germanium detectors have been started: the results from the first years of data taking will be presented.

HK 40.3 Do 17:30 RW 3

Data processing and analysis of the GERDA experiment — •Matteo Agostini for the GERDA-Collaboration — Lehrstuhl für experimentelle Physik und Astroteilchenphysik E15, Physikdepartment der Technischen Universität München

The Gerda experiment searches for the neutrinoless double beta decay of ^{76}Ge using an array of high-purity germanium detectors isotopically enriched in ^{76}Ge. Gerda started the first physical data taking in November 2011, operating eight enriched coaxial detectors (approximately 15 kg of ^{76}Ge). The talk will present the Gerda reference off-line analysis of the Ge detector signals. The Ge detector pulses are processed through sequences of algorithms and digital shaping filters to extract information concerning the signal shape, e.g. maximum amplitude, rise time, baseline slope. These parameters are subsequently used for monitoring the data quality and reconstructing the event features (including the event energy). Eventually the data surviving the quality cuts are used for the physical analysis.

This work was supported by BMBF (05A11W01) and by the Munich Cluster of Excellence "Origin and Structure of the Universe".

HK 40.4 Do 17:45 RW 3

Investigations of the ^{42}Ar background in the LArGe test facility for the GERDA experiment — •Alexey Lubashevskiy for the GERDA-Collaboration — Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, D-69117 Heidelberg, Germany

Gerda is an ultra-low background experiment aimed to search for the neutrinoless double beta decay of ^{76}Ge. The main concept of Gerda is the operation of naked HPGe detectors made from enriched ^{76}Ge, which are immersed in liquid argon (LAr). During the first commissioning runs it was found that cosmogenically produced ^{42}Ar can contribute considerably to the background near the region of interest and the count rate due to decay of its daughter isotope ^{42}K is much higher than expected. It can happen when charged ^{42}K ions are collected by the applied electric field on the detector surfaces. Detailed investigations of the distribution and the behaviour of ^{42}K ions in the LAr under different configurations of the electric field were performed in the low-background test facility LArGe. For this purpose the encapsulated germanium detector GTF-44 was operated in 1 m^3 of LAr in the LArGe setup. By applying different voltage on the encapsulation it is possible to attract or repel charged ions. Moreover, particle decays which deposit part of their energy in LAr can be detected by the scintillation signal using 9 PMTs. In order to increase the statistics and clearly see the effects the LAr was spiked with about 5 Bq of specially produced ^{42}Ar. This allowed to investigate the collection process of ^{42}K and to optimize methods for the suppression of the background from ^{42}Ar.

HK 40.5 Do 18:00 RW 3

Measuring optical properties of LAr in GERDA — •Björn Scholz — TU Dresden, Germany

The GERDA experiment is attempting to measure neutrinoless double beta decay by using Germanium semiconductor detectors which are deployed naked in a volume of liquid Argon (LAr), which acts both as cryogenic cooling and background shield. The experiment recently started its first phase with eight enriched ^{76}Ge detectors and is aiming to test the claims from parts of the Heidelberg Moscow Collaboration. The experiment is now exploring the possibility for instrumenting the LAr as an active veto using the scintillation light produced from energy deposition of background events. In order to optimize the veto design, an accurate knowledge of the LAr optical properties has to be achieved for the specific composition used in GERDA, as these are strongly affected by impurities.

This talk will cover the steps taken in the design of a method to perform the measurement of the LAr properties in GERDA, with particular emphasis on the in-situ measurement of the LAr attenuation length and light yield.

This talk is funded by the BMBF.

HK 40.6 Do 18:15 RW 3

MC Benchmarks for GERDA LAr Veto Designs — •Bjoern Lehnert — TU-Dresden

The GERmanium Detector Array (GERDA) experiment is designed to search for neutrinoless beta decay in ^{76}Ge and is able to directly test the present claim by parts of the Heidelberg-Moscow Collaboration. The experiment started recently its first physics phase with eight enriched detectors, after a 17 month long commissioning period. GERDA operates an array of HPGe detectors in liquid argon (LAr), which acts both as a shield for external backgrounds and as a cryogenic cooling. Furthermore, LAr has the potential to be instrumented and therefore be used as an active veto for background events through the detection of the produced scintillation light. In this talk, Monte Carlo studies for benchmarking and optimizing different LAr veto designs will be presented. LAr scintillates at 128 nm which, combined with the cryogenic temperature in which the detector is operated and its optical properties, poses many challenges in the design of an efficient veto that would help the experiment to reduce the total background level by one order of magnitude, as it is the goal for the second physics phase of the experiment. This work was supported by BMBF.

HK 40.7 Do 18:30 RW 3

Ergebnisse des KASCADE-Grande Experimentes — •Donghwa Kang for the KASCADE-Grande-Collaboration — Karlsruher Institut für Technologie (KIT)

Das KASCADE-Grande Experiment besteht aus einem Array von 37 Detektorstationen auf einer Nachweisfläche von etwa 0.5 km^2. Es untersucht ausgedehnte Luftschauer von Primärteilchen mit Energien von 10^{16} bis 10^{18} eV, wobei sowohl die geladene Komponente der Luftschauer als auch die Gesamtmyonzahl unabhängig davon nachgewiesen

werden. Im Energiespektrum der kosmischen Strahlung bei ungefähr 10^{17} eV werden sowohl ein Eisenknie als auch der Übergang von galaktischer zu extragalaktischer kosmischer Strahlung erwartet.

Basierend auf der gemessenen Anzahl der Elektronen und Myonen können die Energiespektren für leichte und schwere Primärteilchen bestimmt werden. Dabei konnte ein Knick im Spektrum schwerer Primärteilchen eindeutig nachgewiesen werden. In diesem Vortrag werden das Gesamtenergiespektrum und verschiedene Analysemethoden der Massentrennung vorgestellt.