T 65: Niederenergie-Neutrinophysik 3

Zeit: Dienstag 16:45–18:55 Raum: P106

Gruppenbericht T 65.1 Di 16:45 P106

GERDA and the search for neutrinoless double beta decay: first results and perspectives — •Werner Maneschg for the GERDA-Collaboration — Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg

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 with a background index of about 0.01 cts/(keV·kg·yr) were accumulated. 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 phase II of data collection. Thanks to an increased target mass, an improved energy resolution and the introduction of novel background reduction techniques, the sensitivity of Gerda is expected to increase of about one order of magnitude in a few years of operation.

T 65.2 Di 17:05 P106

Setup for an in-situ measurement of the total light extinction of liquid argon in GERDA — •Birgit Schneider for the GERDA-Collaboration — IKTP, TU Dresden, Deutschland

The Germanium Detector Array (GERDA) is an experiment searching for neutrinoless double beta decay in ^{76}Ge. The observation of such a decay would prove the Majorana character of the neutrino and could provide a hint about the neutrino mass and possibly identify the mass hierarchy scheme. GERDA uses germanium detectors which are enriched in ^{76}Ge and operates them naked in liquid argon (LAr), which serves both as a coolant and a shield for external radiation. Phase I of GERDA ended after one and a half year of measurement, in May 2013, with an exposure of 21.6 kg · yr and a background index (BI) of 10^{-2} cts/(kg · yr · keV), after applying pulse shape discrimination techniques. For Phase II it is planned to reach an exposure of 100 kg·yr with a BI of 10^{-3} cts/(kg · yr · keV). One of the key improvements to further reduce the BI is to instrument the LAr to act as an additional background veto. The light extinction of the scintillation light of LAr is a key feature to characterize the LAr instrumentation. It is very dependent on the impurities in the liquid and is needed to determine the effective active LAr veto volume. The work shall include the construction of a setup for such an in-situ measurement as well as the measurement itself. This involves the development of a setup design, the selection of the materials and components such as the calibration source and the photomultiplier with the related electronic parts. In this talk a status report of the activities and results will be presented.

T 65.3 Di 17:20 P106

Study of the double beta decay of ^{76}Ge into excited states of ^{76}Se — •Thomas Wester for the GERDA-Collaboration — Institut für Kern und Teilchenphysik, TU Dresden

The Germanium Detector Array Gerda is an experiment searching for the neutrinoless double beta decay in ^{76}Ge. The observation of such a decay would prove the Majorana character of the neutrino and could provide a hint about the neutrino mass and possibly identify the mass hierarchy scheme.

The half life of the neutrino accompanied double beta decay ($2\nu\beta\beta$) of ^{76}Ge has been measured by Gerda Phase I with unprecedented precision. The observed spectrum comes mostly from from the transition from the 0^+ ground state of ^{76}Ge to the 0^+ ground state of ^{76}Se. However, phase space suppressed $2\nu\beta\beta$ transitions to excited states of ^{76}Se exist as well. At current state, the predicted half lives for such decays vary by several orders of magnitute, due to the large uncertainties in the nuclear matrix elements and the available nuclear models. An observation would therefore help to constrain model parameters and decrease those uncertainties.

A first search for this decay mode using the data from Phase I is currently in progress, which is based on a counting method. Several signal cuts have been investigated and optimized for a maximum in sensitiviy with the help of Monte Carlo simulations to estimate efficiencies and background contributions.

The presentation will discuss the current status and first results of this analysis.

T 65.4 Di 17:35 P106

^{42}K background mitigation for GERDA Phase II — •Alexey Lubashevskiy for the GERDA-Collaboration — Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, D-69117 Heidelberg, Germany

GERDA is a low background experiment aimed for the neutrinoless double beta decay search. The search is performed using high purity germanium detectors operated in liquid argon (LAr). One of the most dangerous backgrounds in GERDA is the background from ^{42}K which is a daughter isotope of cosmogenically produced ^{42}Ar presented in natural argon. ^{42}K ions collect on the surface of the detector and increase its background level. Developments of the suppression methods of such kind of background were performed at LArGe low-background test facility, which gives a possibility to operate bare detectors in about 1 m^3 of LAr. It is equipped with scintillation veto, so particles which deposit part of their energy in LAr can be detected by 9 PMTs. It is located at LNGS underground laboratory close to GERDA experiment. In order to better understand background and to increase statistics the LAr of LArGe was spiked with specially produced ^{42}Ar. Different experimental techniques were tested together with pulse shape dicrimination method and PMT veto in order to suppress ^{42}K background. Obtained results show a possibility to suppress the background below the requirements for GERDA Phase II.

T 65.5 Di 17:50 P106

The SNO+ Experiment: Overview and Status — •Arnd Sörensen, Valentina Lozza, Belina von Krosigk, Marc Reinhard, and Kai Zuber — IKTP, TU Dresden

The SNO+ (Sudbury Neutrino Observatory plus scintillator) experiment is the follow up of the SNO experiment, replacing the heavy water volume with about 780 tons of liquid scintillator (LAB). The location in one of the deepest underground laboratories in the world, and the use of ultra-clean materials makes the detector suitable for low energy neutrino measurements and rare event studies.

The main objective of SNO+ is the search for neutrinoless double beta decay of 130Te (34% natural abundance). For this phase the liquid scintillator will be initially loaded with 0.3% of natural Tellurium, allowing also searches for 8B solar-neutrinos, geo-neutrinos originating from radioactivity in the earth, the possible observation of neutrinos from supernovae and the study of reactor oscillation.

A phase with pure liquid scintillator is then planned, which will allow the detection of pep and CNO solar neutrinos. A review of the general SNO+ setup, the physics goals and the current status will be presented.

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T 65.6 Di 18:05 P106

A Scandium Calibration Source for the SNO+ Experiment — •Marc Reinhard, Valentina Lozza, and Kai Zuber — TU Dresden, Germany

The SNO+ experiment uses the same detector as SNO (Sudbury Neutrino Observatory). The target volume consists of 780 tonnes of liquid scintillator placed in an acrylic sphere of 12 m diameter, surrounded by about 9500 PMTs. Due to its location in a nickel mine 2 km underground (equivalent to 6 km water shielding) it is possible to measure low background physics processes. The main goal of the SNO+ experiment is the search for the neutrino-less double beta decay of Te-130. For this scope, the liquid scintillator will be loaded with 0.3 % natural tellurium.

To understand the detector response well enough, a calibration is necessary. The first calibration will be done in a water filled detector presumably in 2014 followed by calibrations in pure and tellurium loaded liquid scintillator. One of the sources used in the pure scintillator and tellurium phase will be Sc-48 which will be produced by a (n,p) reaction on natural titanium in Dresden-Rossendorf. With the half life of Sc-48 of only 43.67 h a tight schedule for production and shipping is required. For the calibration the 3 gamma rays with a sum energy of 3.333 MeV following the beta decay will be used. The design of the source is greatly affected by safety and cleanliness requirements when shipping and deploying the source. The current status of the source development will be presented.

Gruppenbericht T 65.7 Di 18:20 P106

The COBRA Experiment - Status Report — •Nadine Heidrich for the COBRA-Collaboration — Institut für Experimentalphysik, Universität Hamburg, D

COBRA is a next–generation experiment searching for neutrinoless double beta ($0\nu\beta\beta$) decay using CdZnTe semiconductor detectors. The main focus is on ^{116}Cd, with a decay energy of 2813.5 keV well above the highest 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 the effective Majorana mass.
Within the R&D program, the coplanar grid (CPG) detector technology was delevoped for CdZnTe. In 2013 the number of operated detectors was doubled. Therefore, 64 CPG detectors are currently running at the LNGS with a FADC readout. Due to pulseshape analysis, the background can already be reduced significantly.
In the talk an overview about the COBRA experiment, the detector technology and the recent progress is given. In addition, future plans will be dicussed.

T 65.8 Di 18:40 P106

Aktuelle Ergebnisse des COBRA Experiments — •Thomas Quante für die COBRA-Kollaboration — TU Dortmund, Lehrstuhl für Experimentelle Physik IV, 44221 Dortmund, D

Das COBRA-Experiment sucht nach neutrinolosen Doppelbetazerfällen ($0\nu\beta\beta$) in Cd, Zn und Te Isotopen. Durch das Betreiben des vollständigen Demonstrator Arrays mit 64 CdZnTe-Detektoren konnten viele Erkenntnisse zum Verhalten der verwendeten Halbleiter-Kristalle und deren Langzeitstabilität gewonnen werden, wodurch neue Cuts zur Senkung des Untergrundes definiert werden konnten.

In diesem Vortrag werden die neuen Daten des vollständigen Demonstratorsetups diskutiert. Durch das verbesserte Untergrundniveau konnte die Sensitivität auf seltene Zerfälle stark erhöht werden. Aufgrund der vielen Einzeldetektoren ist es notwendig ein Verfahren zu verwenden, dass die einzelnen Detektoreigenschaften, wie die unterschiedlichen Auflösungen mit in Betracht zieht. Um dies zu erreichen wird die Extended Unbinned Loglikelihood Methode verwendet. Um verlässliche Ergebnisse zu erhalten wurde ebenfalls eine Monte Carlo Studie zu den verwendenten Untergrundmodellen gemacht. In diesem Vortrag wird der aktuelle Stand der Analyse vorgestellt.