HK 23: Astroparticle Physics I

Zeit: Dienstag 14:00–16:00 Raum: HS 18

Gruppenbericht HK 23.1 Di 14:00 HS 18

Search for neutrinoless double beta decay beyond a half-life of 10^{26} yr with GERDA — •Roman Hiller for the GERDA-Collaboration — Universität Zürich

The GERDA collaboration searches for neutrinoless double beta decay ($0\nu\beta\beta$) of ^{76}Ge. A discovery of this hypothetical decay would establish neutrinos as Majorana fermions and imply a violation of lepton number conservation. In GERDA, germanium detectors enriched in ^{76}Ge are deployed in a cryostat filled with liquid argon (LAr). Instrumenting the cryostat with photosensors, scintillation light in the argon can be used to veto external background events. With this concept, GERDA reached an unprecedented low background for germanium detectors and will remain effectively background free up to its design exposure of 100 kg yr. With the latest data release mid 2018 GERDA was the first experiment to surpass a half-life sensitivity of 10^{26} yr for $0\nu\beta\beta$ decay. Afterwards the experiment was upgraded, deploying a new type of germanium detector and improving the LAr instrumentation. A summary of the latest results and an outlook on the performance after the upgrade of the experiment will be given.

Gruppenbericht HK 23.2 Di 14:30 HS 18

Status and prospects of the COBRA experiment — •Stefan Zatschler for the COBRA-Collaboration — TU Dresden, Institut für Kern- und Teilchenphysik

The COBRA experiment at the underground facility LNGS (Italy) is dedicated to the search for the hypothesized neutrinoless double beta-decay ($0\nu\beta\beta$-decay). The observation of this lepton number violating process would prove the Majorana nature of neutrinos and shed light on physics beyond the established Standard Model. In 2018 an upgrade of the COBRA demonstrator to the extended demonstrator (XDEM) was performed by adding nine 6 cm^3 CdZnTe crystals to the existing 4×4×4 array of 1 cm^3 detectors. COBRA XDEM uses improved prototypes of CdZnTe solid state detectors with an instrumented guard-ring electrode to veto surface events as the original demonstrator's main background component. During the preparation phase of this upgrade the setup was optimized for low-threshold operation to investigate the fourfold forbidden non-unique β-decay of ^{113}Cd. The spectral shape of the electron momentum distribution of this highly forbidden decay is expected to strongly dependent on an effective value of the weak axial-vector coupling strength g_A. For the scientific discussion regarding quenching effects that might affect the half-life predictions for the $0\nu\beta\beta$-decay due to an effectively smaller value of g_A such experimental input is in high demand. This talk will present the current experimental status including first results of COBRA XDEM and summarize the spectral shape analysis of the ^{113}Cd β-decay as well as ongoing studies of exotic $\beta\beta$-decay modes. COBRA is funded by the DFG.

HK 23.3 Di 15:00 HS 18

Double beta decay transitions of ^{76}Ge into excited states of ^{76}Se — •Thomas Wester and Birgit Schneider for the GERDA-Collaboration — IKTP, TU Dresden

The search for the neutrinoless double beta decay is one of the most active fields in modern neutrino physics. An observation would imply lepton number violation and provide valuable information about the neutrino mass mechanism. The GERDA experiment searches for the neutrinoless double decay in ^{76}Ge, by operating an array of isotopically enriched germanium detectors in a liquid argon cryostat.

This contribution discusses the search for two-neutrino and neutrinoless double beta decay transitions of ^{76}Ge into the three energetically lowest excited states of ^{76}Se performed with the Phase II data of GERDA. Due to phase space suppression, the predicted half-lives of those transitions are longer than the ground state transitions. Unfortunately, the predictions additionally vary by several orders of magnitude, due to large uncertainties in the calculations of the nuclear matrix elements. An observation of even the two-neutrino modes would therefore help to constrain model parameters and decrease such uncertainties also for neutrinoless transitions into the ground state and excited states. The sensitivity of GERDA covers several of the predicted half-lives.

An event counting method is performed based on coincident events between two germanium detectors. The analysis procedure and preliminary results will be presented.

HK 23.4 Di 15:15 HS 18

The Liquid Argon Veto System for the Gerda Phase II Upgrade — •Patrick Krause — Technische Universität München, Garching, Germany

Liquid Argon (LAr) scintillates upon interaction with ionizing radiation. In this process light with a wavelength of 128 nm is emitted. With the help of so-called wavelength shifting (WLS) fibres and silicon photomultipliers (SiPMs), this property is an element of Gerda's active background suppression strategy to reject events with coincident energy deposition in the germanium detectors and the surrounding LAr. An improved version of the WLS fiber-modules and the SiPM-readout has been developed. This talk will report the changes, challenges and improvements compared to the previous design. Furthermore the first results of the new LAr veto system in Gerda Phase II+ will be presented.

This work has been supported in part by the German Federal Ministry for Education and Research (BMBF) Verbundforschung 05A17W02 and the German Research Foundation (DFG) via the SFB1258.

HK 23.5 Di 15:30 HS 18

Probing new physics with double-beta decay in Gerda Phase II — •Elisabetta Bossio for the GERDA-Collaboration — PhyPhysik-Department , Technische Universität München, James-Franck-Straße, 85748 Garching

The main goal of the GERmanium Detector Array (Gerda) experiment at the Laboratori Nazionali del Gran Sasso of INFN (Italy) is the discovery of the neutrinoless double-beta ($0\nu\beta\beta$) decay of ^{76}Ge. In Gerda Phase II, the Liquid Argon veto system and the Pulse Shape Discrimination (PSD) allow to have marginal background in the $2\nu\beta\beta$-decay dominated region of the spectrum. This makes the search for other exotic processes attractive: models involving Majorons or Lorentz violating physics predict different shapes of the measured spectrum. Systematic uncertanties due to the background modeling are expected to be small. On the other hand different sources of systematics related to detector physics become important. A study of the dominant systematics and their impact on the sensitivity for new physics will be presented.

This work has been supported in part by the German Federal Ministry for Education and Research (BMBF) and the German Research Foundation (DFG) via the SFB1258.

HK 23.6 Di 15:45 HS 18

Plate-out and removal of radon daughters from material surfaces — •Stefan Bruenner — Max-Planck-Institut für Kernphysik, Heidelberg

Surface contaminations with long lived Rn-222 daughters crucially contribute to the background in many rare event search experiments. In this talk we discuss different plate-out mechanisms of radon daughters on materials with a main focus on PTFE. Several cleaning procedures have been investigated by means of alpha-spectroscopy for their capability to remove Pb-210 and Po-210 from surfaces and the results will be presented. The goal of this study is to identify dedicated cleaning methods matched with the different materials and contaminations.