HK 14: Astroparticle Physics I

Zeit: Dienstag 11:00–12:30 Raum: F 33

Gruppenbericht HK 14.1 Di 11:00 F 33

First results of GERDA Phase II — •ANNE WEGMANN for the GERDA-Collaboration — Max-Planck-Institut für Kernphysik, Heidelberg

The GERDA experiment is searching for neutrinoless double beta ($0\nu\beta\beta$) decay of ^{76}Ge. GERDA operates bare Germanium detectors in liquid argon, that are enriched in the $\beta\beta$ isotope. Phase II of the experiment combines for the first time the excellent properties of semiconductor Germanium detectors with an active background suppression technique based on the simultaneous detection of liquid argon scintillation light by photomultiplier tubes and silicon photomultipliers coupled to scintillating fibers (LAr veto).

This talk outlines the Phase II upgrade with special emphasis on background rejection techniques and focusses on the first results of Phase II. Exhibiting the world-best background index (if normalized to the narrow energy-signal region of Germanium detectors), a limit on the $0\nu\beta\beta$-decay half-life of $5.3 \cdot 10^{25}$ yr at 90% C.L. could be set based on an exposure of only 34.4 kg·yr. With an ultimate exposure of 100 kg·yr this will allow for a $0\nu\beta\beta$-decay half-life sensitivity of the GERDA Phase II experiment of 10^{26} yr.

HK 14.2 Di 11:30 F 33

Performance of Germanium detectors in GERDA Phase II — •ANDREA LAZZARO for the GERDA-Collaboration — Physik-Department and Excellence Cluster Universe, Technische Universität München, Germany

The GERDA experiment searches for neutrinoless double beta decay with Ge semiconductor detectors operated in liquid Ar. The Phase II of the experiment is taking data since December 2015. The goal is to increase the sensitivity for the half–life of ^{76}Ge above 10^{26} yr.

Two types of high purity Ge detectors, enriched in ^{76}Ge, deployed: semi–coaxial and *BEGe*. These detectors have excellent energy resolution and allowed pulse shape discrimination of the main background sources: multiple–site events; external α's and β's.

In this talk I will present the performance of the detectors during the first part of the Phase II data–taking. The stability of the spectroscopy parameters, as energy calibration and resolution, is fundamental to operate a modular system. I will also discuss the active suppression of the different background components. This work was supported by the BMBF.

HK 14.3 Di 11:45 F 33

Pulse shape discrimination performance of BEGe detectors in GERDA Phase II — •ANNA JULIA ZSIGMOND for the GERDA-Collaboration — Max Planck Institut für Physik, München

The GERDA experiment searches for the lepton number violating neutrinoless double beta ($0\nu\beta\beta$) decay of ^{76}Ge. Bare Ge diodes are operated in liquid argon at cryogenic temperatures in an ultra-low background environment. Isotopically enriched Broad Energy Germanium (BEGe) detectors are used in Phase II of the experiment because of their superior energy resolution and pulse shape discrimination properties. $0\nu\beta\beta$ events are single-site events confined in the detector active volume to a scale of about a millimeter, while most of the backgrounds are multi-site gamma-ray events or surface events. These events are identified by a single parameter, the amplitude of the change pulse over the energy of the event and rejected to maximize the sensitivity of the experiment. The long-term stability and performance of the detectors during Phase II data taking using calibration and $2\nu\beta\beta$ data will be presented. The effect of pulse shape discrimination on the background index and $0\nu\beta\beta$ half-life limit will be demonstrated.

HK 14.4 Di 12:00 F 33

Development of novel pulse shape discrimination algorithms for GERDA — •PHILIPP HOLL for the GERDA-Collaboration — Max-Planck-Institut für Physik, München

The GERDA experiment located at the Laboratori Nazionali del Gran Sasso of INFN searches for neutrinoless double beta decay using germanium diodes as source and detector. Its sensitivity strongly depends on the background. Pulse shape discrimination is used for the rejection of background events where multiple energy depositions happen inside the detector or the energy is deposited at the surface of the detector.

In this talk, a novel approach to pulse shape analysis making use of different digital signal processing filters and state-of-the-art machine learning algorithms will be presented. Preliminary results on the training of the classifiers will be shown using ^{228}Th calibration data from GERDA.

HK 14.5 Di 12:15 F 33

Muon-induced Neutrons in GERDA — •LAURA VANHOEFER for the GERDA-Collaboration — Max-Planck-Institut für Physik, München

Neutrons can produce background in experiments searching for rare events like neutrinoless double beta ($0\nu\beta\beta$) decay. GERDA is using germanium detectors operated in liquid argon to search for the $0\nu\beta\beta$ decay of ^{76}Ge. Since the signature is a peak at the Q-value of the decay, $Q_{\beta\beta}$ (2039 keV for ^{76}Ge), any energy deposition around the Q-value is potential background. Neutrons can produce long-lived radioisotopes inside the experiment via neutron capture, spallation etc. or excite nuclei. Energy deposition from the decay/de-excitation can mimic a $0\nu\beta\beta$ signal.

If the neutron flux inside the experiment is known, this background can be estimated. Neutron capture on germanium was used as a signature for determining the muon-induced neutron flux inside GERDA. This allows to refine background predictions for future ton scale $0\nu\beta\beta$ germanium experiments.