T 116: Experimentelle Techniken der Astroteilchenphysik 4

Zeit: Donnerstag 16:45–18:05 Raum: VG 0.110

Gruppenbericht T 116.1 Do 16:45 VG 0.110

A liquid argon scintillation veto for GERDA and LArGe — •Mark Heisel 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. Bare germanium detectors are operated in a cryostat with 65 m^3 of liquid argon (LAr). It has been demonstrated in the LArGe test facility, that the detection of argon scintillation light can be used to effectively suppress background events in the germanium, that simultaneously deposit energy in LAr (LAr veto). Suppression factors up to 10^3 have been achieved for individual sources. Based on these results, Gerda pursues several options for the light instrumentation of LAr, which have to be compatible with the stringent radiopurity requirements of the experiment and should provide a significant suppression of the background in the region of interest around $Q_{\beta\beta}$ at 2039 keV.

This talk gives an account of the competing design options under investigation in the Gerda collaboration. Our main design options using photomultiplier tubes (PMT) and silicon photomultipliers (SiPM) are discussed. Their expected performance and progress of development is reported. In addition, results of the LArGe test facility are presented, along with the design criteria that follow for light instrumentation in Gerda.

T 116.2 Do 17:05 VG 0.110

Attenuation length measurements of liquid Argon — •Alexander Neumeier[1], Thomas Dandl[1], Thomas Heindl[1], Martin Hofmann[1], Lothar Oberauer[1], Walter Potzel[1], Stefan Schönert[1], Jochen Wieser[2], and Andreas Ulrich[1] — [1]TU München — [2]Optimare GmbH Wilhelmshaven

In the recent years liquified rare gases have been proven to be good detector media for particle physics, e.g. for the search for Dark Matter or the neutrinoless double β-decay. These detectors most often use the UV scintillation light emitted by the rare gas being excited or ionized by a traversing charged particle. One important key point to fully understand the detector response is the determination of the attenuation length of the liquid rare gas at the wavelength of its scintillation light. In this talk a table-top setup for the measurement of these attenuation lengths is presented, which uses a deuterium arc lamp as light source in the VUV and UV range and a monochromator with an intensified diode array detector as read-out system. The liquified rare gas is contained in a target cell with MgF_2-windows and condensed, re-evaporated and cleaned in a continuous mode. The results of the spectrally resolved measurements with liquid Argon with two different cell lengths (58 mm and 116 mm) will be shown and discussed. The influence of gas impurities has been studied, too, showing that even small concentrations of water and Xenon in the liquid Argon can severly deteriorate the light transmission.

This work has been supported by founds of the Maier-Leibnitz-Laboratorium Garching.

T 116.3 Do 17:20 VG 0.110

Purification Methods for Xenon — •Stephan Rosendahl, Ethan Brown, Volker Hannen, Christian Huhmann, Hans Kettling, Johannes Schulz, and Christian Weinheimer — Institut für Kernphysik, Universität Münster

The Xenon Project uses a 2 phase time projection Chamber (TPC) to search for dark matter by detecting a nuclear recoil signal, induced by Weakly Interacting Massive Particles (WIMPs). An interaction between WIMPS and the target nuclei produces scintillation and charge signals. The electrons are drifted in an electric field to the gas phase where they are extracted to produce fluorescence light in xenon gas. Both light signals are detected by arrays of photomultiplier tubes on the top and bottom of the detector. The drift length of the electrons in liquid xenon strongly depends on the content of electronegative impurities. Furthermore Kr-85, which contributes to radioactive backgrounds, must be removed from the commercial xenon to the ppt level.

In Münster we set up a system to remove the electronegative impurities with a zirconium purifier and using cryogenic distillation to remove Kr-85 isotopes from the xenon. The quality of the xenon is investigated, using a dual phase xenon TPC, in combination with a laser based moisture analyzer and a quadrupol mass filter to have a complementary setup of different tools. The whole system is designed to perform R&D studies for the Xenon1T experiment, which is the next generation of direct dark matter detectors.

The project is supported by DFG and the state NRW, contract number INST 211/528-1 FUGG and by BMBF, number 05A11PM1.

T 116.4 Do 17:35 VG 0.110

GERDA phase II detectors and acceptance tests — •Victoria Wagner for the GERDA-Collaboration — Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, D-69117 Heidelberg

The GERDA collaboration aims at searching for the neutrinoless double beta decay of ^{76}Ge into ^{76}Se. It uses enriched Ge detectors that are operated in liquid argon. Phase I of the experiment started with a target mass of approximately 20 kg on November 1, 2011, and it will last for 1 year. Phase II is in preparation and envisions the installation of at least 25 new Broad Energy Ge detectors (BEGe) that will increase the target mass by nearly 20 kg. These detectors, however, have to be extensively tested prior to their usage.
The talk briefly reviews the preparation of the detector screening campaign and focuses on the corresponding acceptance test strategy. The tests include energy resolution and leakage current measurements, dead layer and active volume determination, as well as the pulse shape discrimination efficiencies of the detectors. Finally we present results obtained with depleted BEGe detectors that are used for the optimization of the enriched ones during the acceptance tests.

T 116.5 Do 17:50 VG 0.110

Das ereignisbasierte Datenauslesesystem für die EDELWEISS Dark Matter Suche — •Bernhard Siebenborn für die EDELWEISS-Kollaboration — Karlsruher Institut für Technologie, IEKP, Postfach 3640, 76021 Karlsruhe

Das EDELWEISS Experiment benutzt kryogene Germanium-Monokristalle (T=18mK) zur direkten Suche nach Dunkler Materie. Ein Ge-Kernrückstoß aufgrund einer elastischen Streuung eines WIMPs (Weakly Interacting Massive Particle) kann dabei durch gleichzeitige charakteristische Phonon- und Ladungs-Signale identifiziert werden. Für die nächste Ausbaustufe, EDELWEISS-III, werden in 2012 40 Detektoren mit je 800g Masse und 6 Auslesekanälen (4x Ionisation + 2x Wärme) bei 100kS/s Sampling-Rate (bis zu 40MS/s für zeitaufgelöste Ionisationssignale) installiert. Die Rohdaten werden über FET-Stufen bei 100K verstärkt, dann in speziellen inhouse-Elektronikboxen digitalisiert und per Glasfaser weitergeleitet. Zur Datenauslese wurde am KIT ein modulares und skalierbares Elektroniksystem mit hoher Integrationsdichte entwickelt und aufgebaut, das mittels FPGA basiertem Trigger eine ereignisorientierte Datenaufnahme ermöglicht. Die neue Struktur erlaubt ein rohdatennahes eventbuilding, kompakte Hardware und die Integration anderer Detektorsysteme, wie dem Myonveto. Der Vortrag gibt eine Übersicht über die verwendete Auslese-Elektronik, die implementierten Trigger-Algorithmen und Ergebnisse der ersten Messphase.

Gefördert durch das BMBF (Verbundforschung ATP 05A11VK2) und durch die Helmholtz-Allianz für Astroteilchenphysik HAP.