T 32: Dunkle Materie 2

Zeit: Montag 16:45–19:00 Raum: P11

T 32.1 Mo 16:45 P11

Measuring the charge yield of electromagnetic interactions with XENON100 — •Ludwig Rauch on behalf of the XENON Collaboration — Max-Planck-Institut für Kernphysik, Heidelberg

The XENON100 experiment is not only sensitive to dark matter particles scattering off a nucleus but also probes new particles beyond the standard model which produce electronic recoils. To understand the signatures of such particles in liquid xenon, one needs to study the energy dependence of the charge yield for such interactions. In this talk an analysis, able to measure the charge yield with the XENON100 detector is introduced. This is achieved by selecting double scattered photons of a Cs137 calibration source within the dual phase time protection chamber of XENON100. For these events it is possible to reconstruct the Compton angle via a kinematic approach due to the high vertex resolution of the detector. In addition to the method, first results will be presented.

T 32.2 Mo 17:00 P11

Construction and Simulation of a Compton scatter experiment with a dual-phase Xenon-TPC and a germanium detector — •Melanie Scheibelhut, Bastian Beskers, Cyril Grignon, Pierre Sissol, Uwe Oberlack, and Rainer Othegraven — Johannes Gutenberg Universität Mainz

The most sensitive dark matter search experiments today are based on the concept of a dual-phase xenon time projection chamber. The ton-scale is already under construction (XENON1T), and detectors at the 10 ton scale are being envisioned (e.g., DARWIN). Yet, the low energy behavior of liquid xenon is still not well understood. The MainzTPC is a small 3D position sensitive, dual phase xenon TPC to measure charge and scintillation yield at recoil energies of a few keV and to study the liquid xenon scintillation pulse shape. We constructed a Compton scatter experiment to study the electronic recoils due to low energy scattering of gamma-rays. Here we discuss the experimental set-up, characterisation of the germanium detector, and simulations including the MainzTPC.

T 32.3 Mo 17:15 P11

Design and comissioning of the Mainz Xenon dual-phase TPC — •Bastian Beskers, Pierre Sissol, Melanie Scheibelhut, Cyril Grignon, Uwe Oberlack, and Rainer Othegraven — Johannes Gutenberg Universität Mainz

Dark Matter detectors based on dual-phase xenon Time Projection Chambers (TPC) have been setting the most stringent limits in the past decade (Xenon10, Xenon100) and are still leading the field (LUX). Bigger detectors in the ton scale (XENON1T) based on the same detection principles are in construction phase and in the multi-ton scale (DARWIN) are being envisioned. Despite the success of those experiments, the behaviour of xenon for low energy recoils (few keV) is still not well understood. With the MainzTPC, a small 3D position-sensitive dual-phase xenon TPC, we will measure the xenon response in the low energy regime with better precision than previous experiments and study the liquid xenon scintillation pulse shape. We report on the perfomance of the large area avalanche photo diodes (APD) used to detect xenon scintillation light (VUV) and the comissioning of the xenon dual-phase TPC.

T 32.4 Mo 17:30 P11

Electrostatic Field Calculations for a Dual Phase Noble Gas WIMP Detector — •Julien Wulf, Guido Drexlin, Ferenc Glück, Daniel Hilk, and Thomas Thümmler — KIT Center Elementary Particle and Astroparticle Physics (KCETA)

In the last years, dual phase noble gas detectors like XENON100 or LUX delivered today's most accurate limits on WIMP-nucleon cross-sections with $\sigma < 10^{-45}\text{cm}^2$. To push the sensitivity to $\mathcal{O}(10^{-48}\text{cm}^2)$, several international groups are working within a consortium on the technical design report for DARWIN (**DAR**k matter **WI**mp search with **N**oble liquids), a facility housing two multi-ton detectors combining both technologies from the Argon- and Xenon-based experiments. The detection principle of a dual phase noble gas detector allows an excellent background discrimination. In order to design this kind of detectors, it is indispensable to study and optimize the electrostatic properties of the detector geometry in advance. Therefore, the simulation software KEMField has been used, which has originally been developed for the KATRIN experiment. KEMField utilizes the Boundary Element Method, which is advantageous especially for simulating small scale wire structures within large volumes. For DARWIN a parallelized GPU/MPI version of KEMField has been used in order to decrease the computation time by a factor of 100.
This talk shows a comparison of KEMField against Finite Element based simulation software and discusses an electrostatic simulation of an exact CAD-based DARWIN model. This work was supported by the BMBF under grant no. 05A11VK3 and by the Helmholtz Association.

T 32.5 Mo 17:45 P11

Development of Neganov-Luke Amplified Cryogenic Light-Detectors for Current and Future Rare Event Searches. — •Michael Willers for the TUM E15 Kryodetektor-Collaboration — Technische Universität München, Physik Department E15, James Franck Straße, 85748 Garching

Ultra-low background experiments that employ the phonon-light technique for an active background suppression (e.g. the direct dark matter search experiment CRESST-II and the planned EURECA experiment or future experiments searching for the neutrino-less double beta decay) rely heavily on the sensitivity of the cryogenic light-detector at low energies.

Neganov-Luke (NL) amplified cryogenic light-detectors offer a promising way to increase the sensitivity by drifting photon induced electrons and holes in a semiconductor in an applied electric field and thus amplifying the phonon signal. In this talk, we will present recent results obtained with such NL amplified cryogenic light-detectors and possible future applications.

This research was supported by the DFG cluster of excellence "Origin and Structure of the Universe", the "Helmholtz Alliance for Astroparticle Phyiscs" and the "Maier-Leibnitz-Laboratorium"(Garching).

T 32.6 Mo 18:00 P11

Attenuation of Vacuum Ultraviolet Light in Liquid Argon — •Alexander Neumeier[1], Thomas Dandl[1], Thomas Heindl[1], Martin Hofmann[1], Lothar Oberauer[1], Walter Potzel[1], Stefan Schönert[1], Andreas Ulrich[1], and Jochen Wieser[2] — [1]Physik-Department E12/E15, TU-München, James-Franck-Str. 1, 85748 Garching — [2]Excitech GmbH, Branterei 33, 26419 Schortens

Liquid noble gases, argon and xenon, in particular, are excellent high density scintillator media with a high scintillation efficiency. Detectors use the scintillation light emitted by the noble gases excited by a traversing charged particle. In large-volume detectors it is important to understand the attenuation of the scintillation light in the medium to determine the detector response. We will present wavelength resolved absorption spectra of vacuum ultraviolet (VUV) light in liquid argon (A. Neumeier et al., Eur. Phys. J. C (2012) 72:2190). The light emitted by a broad-band VUV light source (D2-lamp) was sent through 58mm of liquid argon and subsequently analyzed with an evacuated VUV monochromator. The results show a strongly reduced transmission due to water and xenon impurities. The latter can not be removed by conventional noble gas purification techniques. Only a combined purification of fractional distillation and conventional rare gas purification leads to an attenuation length of the order of meters.

This research was supported by the DFG cluster of excellence 'Origin and Structure of the Universe' and the Maier-Leibnitz-Laboratorium München.

T 32.7 Mo 18:15 P11

A liquid argon scintillation veto for the Gerda experiment — •Christoph Wiesinger for the GERDA-Collaboration — Technische Universität München, Physik Dep., E15, James-Franck-Straße, 85748 Garching

Gerda is an experiment to search for the neutrinoless double beta decay of ^{76}Ge. Results of Phase I have been published in summer 2013. Currently Gerda is being upgraded to a second phase. To reach the aspired background index of $\leq 10^{-3}$ cts/(keV·kg·yr) for Phase II active background-suppression techniques will be applied, including an active liquid argon veto (LAr veto).

It has been demonstrated by the LArGe test facility that the detection of argon scintillation light can be used to effectively suppress background events in the germanium, which simultaneously deposit energy in LAr.

This talk focusses on the light instrumentation which is being installed in Gerda. Photomultiplier tubes (PMT) and wavelength-shifting fibers connected to silicon photomultipliers (SiPM) are used to maximize the photoelectron-yield with respect to various background sources. Monte Carlo simulations have been performed to optimize the design for background suppression and low self-induced background. First results of the prototypes and the progress of installation are reported.

T 32.8 Mo 18:30 P11

Radon Screening und Reinigung im XENON1T Experiment — •Stefan Bruenner — Max-Plank-Institut für Kernphysik, Heidelberg

Radon, insbesondere dessen Isotop ^{222}Rn, ist bekannt als Untergrundquelle in vielen Experimenten mit niedriger Ereignisrate geringer Energie. Das gilt auch für den sich gerade in Bau befindlichen XENON1T Detektor welcher den direkten Nachweis Dunkler Materie erbringen soll. Um die zum Ziel gesetzte Untergrundrate von $5 \cdot 10^{-5} \frac{events}{day \cdot kg \cdot keV}$ zu erreichen soll die Radonkontamination auf $<1\ \mu$Bq/kg gedrückt werden. In diesem Vortrag wird gezeigt wie Materialien auf ihre Radonemanation überprüft werden um zu gewährleisten, dass nur *saubere* Komponenten für den Bau des XENON1T Detektors verwendet werden.
Desweiteren werden verschiedene Techniken zur Realisierung eines Radonreinigungssystems, welches direkt in den Gasreinigungskreislauf des Experiments integriert werden soll, vorgestellt. Dieses Reinigungssystem soll *online*, d.h. wärend des Detektorbetriebes, das emanierende Radon filtern und somit den internen Untergrund weiter verringern.

T 32.9 Mo 18:45 P11

Krypton in Xenon Messungen mit ppq-Sensitivität für XENON — •Dominik Stolzenburg, Sebastian Lindemann und Hardy Simgen — Max-Planck-Institut für Kernphysik, Heidelberg

Flüssig Edelgas Detektoren sind eine der erfolgversprechendsten Möglichkeiten bei der Suche nach einem direkten Nachweis dunkler Materie. XENON100 gehört hier zu den führenden Experimenten. Das in der Bauphase befindliche Nachfolge-Experiment XENON1T soll durch eine größere sensitive Masse und eine weitere Untergrundreduzierung um eine Größenordnung noch erfolgreicher werden. Eine der größten Herausforderungen ist dabei intrinsisches Kr, dessen Untergrundbeitrag durch den Betastrahler 85Kr nicht durch die Selbstabschirmung des Xe reduziert werden kann. Externes Monitoring des Kr Gehalts ist deswegen für hoch sensitive LXe Experimente unerlässlich. Am MPIK wird hierfür ein Edelgas Massenspektrometer in Kombination mit einem gaschormatografischen Kr/Xe-Trennverfahren verwendet. Kürzlich durchgeführte Verbesserungen am bestehenden Aufbau ermöglichen einen Nachweis von wenigen ppq (parts-per-quadrillion) Kr/Xe, ausreichend für die Ziele von XENON1T. Darüber hinaus werden einige Ergebnisse jüngster Xe-Messungen präsentiert, die das Leistungsvermögen und die Stabilität des Aufbaus demonstrieren.