T 55: Suche nach Dunkler Materie 2 (Direkter Nachweis)

Zeit: Dienstag 16:45–19:10 Raum: VSH 19

Gruppenbericht T 55.1 Di 16:45 VSH 19

The DEAP-3600 Dark Matter Experiment — •Tina Pollmann[1] and DEAP collaboration[2] — [1]Technische Universität München — [2]SNOLAB, Sudbury, Canada

DEAP-3600 is a single-phase liquid-argon Dark Matter direct detection experiment located 2 km underground at SNOLAB, in Sudbury, Canada. With a 1 tonne fiducial mass, the target sensitivity to spin-independent scattering of 100 GeV weakly interacting massive particles (WIMPs) is 10^{-46} cm^2. The detector was designed and built to reach a background level of less than 0.6 events in 3 tonne-years exposure. This included designing all parts of the detector to prevent or veto backgrounds, radio-purity screening for all detector materials, working with suppliers to source radio-pure materials, and using construction techniques that limit contaminations with radio-isotopes. The largest remaining background - beta decays from Ar-39 - is mitigated offline through pulse shape analysis. DEAP-3600 finished commissioning in 2015 and is now taking physics data. This paper presents commissioning results and the status of the experiment.

Gruppenbericht T 55.2 Di 17:05 VSH 19

Status of the XENON1T experiment — •Alexander Fieguth for the XENON-Collaboration — Institut fuer Kernpyhsik WWU, Muenster, Deutschland

The XENON Collaboration aims for the direct detection of dark matter by spin-independent and spin-dependent scattering off xenon nuclei with a dual-phase time projection chamber (TPC) working in an ultra-low background environment at the Gran Sasso Underground Laboratory in Italy. After the successful operation of XENON100 with its 161 kg xenon target, the next step XENON1t with 3.3 tons of xenon has been started. The aim for its operation is to reach a sensitivity for the spin-independent WIMP-nucleon cross section of 1.6×10^{-47}cm^2 for a WIMP mass of 50 GeV/c^2 after a 2 ton-year exposure. We will present the status of the running XENON1T experiment. Additionally an outlook on its future upgrade XENONnT will be given. The work of the author is supported by BMBF under contract number 05A14PM1 and DFG (GRK 2149).

T 55.3 Di 17:25 VSH 19

Calibration of the XENON1T detector — •Constanze Hasterok for the XENON Collaboration — Max-Planck-Institut für Kernphysik (MPIK)

Massive weakly interacting particles are a popular explanation for most of the dark matter evidences seen on several astrophysical scales. With its unprecedented sensitivity the new XENON1T detector will play a leading role in the direct detection search of WIMPs. It uses the time projection chamber (TPC) technique in combination with a liquid xenon target of 2 tons in the sensitive volume. A precise understanding of all detector properties is crucial for the dark matter analysis. Furthermore, calibration measurements are used to model the expected background which is important for the evaluation of the significance of a potential signal. For this purpose, several calibration sources have been deployed. Short lived radioactive isotopes like 83mKr and 220Rn have been dissolved directly in the xenon target. External sources like the gamma emitting 228Th and the neutron emitter AmBe have been brought next to the cryostat. This talk will present the different calibration methods used at the XENON1T detector and their main results.

T 55.4 Di 17:40 VSH 19

Online krypton removal at the XENON1T experiment — •Michael Murra for the XENON-Collaboration — Institut Für Kernphysik, Münster

The operating XENON1T experiment, located in the Laborati Nazionali del Gran Sasso (LNGS), is the next generation experiment for the direct detection of dark matter in the form of Weakly Interacting Massive Particles (WIMPS). The new detector utilizes about 3.3 tons of liquid xenon in order to reach a projected sensitivity of 1.6×10^{-47} cm^2 for a WIMP mass of 50 GeV/c^2. A key requirement to reach this sensitivity is the reduction of radioactive backgrounds such as ^{85}Kr, which has a beta-decay with an endpoint energy of 687 keV. Due to the difference in vapor pressure, the concentration of natural krypton in xenon can be reduced by several orders of magnitude by using a cryogenic distillation column. Such a distillation column has been operated in a closed loop with the XENON1T detector system in order to reduce the krypton concentration below 1 ppt for the first dark matter run. This so-called online removal will be presented within this talk. Different aspects of this project have been funded by DFG Großgeräte, BMBF and Helmholtz-Alliance for Astroparticle Physics (HAP).

T 55.5 Di 17:55 VSH 19

Simulations and Experiment with a small dual-phase xenon TPC — •Melanie Scheibelhut[1], Bastian Beskers[1], Pierre Sissol[1], Uwe Oberlack[1], Arnd Junghans[2], and Roland Beyer[2] — [1]Johannes Gutenberg-Universität Mainz — [2]Helmholtz-Zentrum Dresden-Rossendorf

The MainzTPC is a small dual-phase xenon Time Projection Chamber (TPC), built to measure the scintillation and ionization yield of low-energy nuclear and electronic recoils (few keV range). The goal is to deepen the understanding of liquid xenon as a detection material, especially in the low-energy regime which is important for e.g. direct Dark Matter search experiments. For the measurement we built a scattering experiment for both electronic and nuclear recoils. To measure the response to electronic recoils, a Cs137 source in a Compton-scatter setup in combination with a germanium detector was used for the energy measurement. For the nuclear recoils, neutrons produced at the nELBE neutron time-of-flight facility at the ELBE accelerator of the Helmholtz-Zentrum Dresden-Rossendorf (HZDR) were used. For the detection of the scattered neutron, plastic scintillators were placed to measure the energy via time of flight or scatter angle. In addition, a detailed Monte Carlo simulation (GEANT4) of the experiment has been performed to compare it to the experimental results. Here we report about simulations with the MainzTPC at the HZDR.

T 55.6 Di 18:10 VSH 19

Particle Identification via Liquid Argon-Xenon Scintillation — •Andreas Himpsl[1], Thomas Dandl[1], Stefan Schönert[1], Andreas Ulrich[1], and Jochen Wieser[2] — [1]Physik Department E15, Technische Universität München — [2]Excitech GmbH, Branterei 33, 26419 Schortens, Germany

Intense infrared scintillation light with a center wavelength of 1173nm was found in liquid argon with a 10ppm xenon admixture (A. Neumeier EPL 109, 12001, 2015). The admixture also shifts the well known 130nm scintillation of argon to the corresponding xenon emission at 175nm. We present the results of a study in which we compare the intensity of the two emission bands (VUV and NIR) for excitation by different projectiles. Low energy (10keV) electrons and various ions such as carbon, sulfur, and iodine with energies of several MeV/u are used for that purpose. The scintillation light is detected with two phototubes with selective sensitivity in the VUV and NIR, respectively. The goal is to test whether the emission bands can be used for purely optical particle identification in liquid argon detectors with a xenon admixture. This work was supported by the DFG Excellenzcluster Origin and Structure of the Universe and the Maier-Leibnitz-Laboratorium Garching.

T 55.7 Di 18:25 VSH 19

Absolute and Relative Reflectivity Measurements and Light Collection Efficiency Studies for the CRESST Experiment — •Alexander Langenkämper, Xavier Defay, Jean-Côme Lanfranchi, Erik Lindner, Elizabeth Mondragón, Andrea Münster, Corbinian Oppenheimer, Tobias Ortmann, Walter Potzel, Stefan Schönert, Hong Hanh Trinh Thi, Andreas Ulrich, Stephan Wawoczny, Michael Willers, and Andreas Zöller — Technische Universität München, Physik Department Lehrstuhl E15 und Excellence Cluster Universe, James-Franck-Straße, D-85748 Garching

The CRESST experiment aims for the direct detection of Dark Matter via elastic scattering off nuclei in $CaWO_4$ single crystals. The detectors are operated at mK temperatures and consist of the target crystal as well as a separated light detector. The simultaneous readout of phonon and light detector is used for particle identification. To increase the light collection both detectors are surrounded by a reflecting and scintillating foil which is characterised in this work. The results of wavelength and angle dependent absolute reflectivity measurements at 300 K as well as relative reflectivity measurements between 300 K and 20 K will be presented. The results are implemented in a GEANT4 simulation to study the light collection efficiency in CRESST detector modules and first results will also be shown. This work was supported by the DFG Excellenzcluster Origin and Structure of the Universe and the Maier-Leibnitz- Laboratory (Garching).

T 55.8 Di 18:40 VSH 19

Production of Sputtered Tungsten TES for the CRESST III Experiment — •Tobias Ortmann, Xavier Defay, Jean-Côme Lanfranchi, Alexander Langenkämper, Erik Lindner, Elizabeth Mondragón, Andrea Münster, Corbinian Oppenheimer, Walter Potzel, Stefan Schönert, Hong Hanh Trinh Thi, Andreas Ulrich, Stephan Wawoczny, Michael Willers, and Andreas Zöller — Technische Universität München, Physik Department Lehrstuhl E15 und Exzellenzcluster Universe, James-Franck-Straße 1, D-85748 Garching

The CRESST experiment (Cryogenic Rare Event Search with Superconducting Thermometers) searches for nuclear recoils events induced by elastic scattering of dark matter particles off the target nuclei within $CaWO_4$ target crystals. The detectors are operated at a temperature of $\mathcal{O}(10\,\mathrm{mK})$ and consist of the target crystal and a seperate cryogenic detector. Both heat (phonon) and light signals are read out via a tungsten TES (Transition Edge Sensor) utilizing the superconduction phase transition of tungstent measure the energy deposited in the absorbers. So far the TES are produced via electron beam evaporation. In this work the production via argon ion sputtering is investigated in terms of film quality and reproductibility. The first results are presented. This work was supported by the DFG Excellenzcluster Origin and Structure of the Universe and the Maier-Leibnitz- Laboratory (Garching).

T 55.9 Di 18:55 VSH 19

An alternative approach to Neganov-Trofimov-Luke cryogenic light detectors for Rare Event searches — •Elizabeth Mondragón[1], Xavier Defay[2], Alexander Langenkämper[1], Jean-Côme Lanfranchi[1], Erik Lindner[1], Andrea Münster[1], Corbinian Oppenheimer[1], Tobias Ortmann[1], Walter Potzel[1], Stefan Schönert[1], Hong Hanh Trinh Thi[1], Andreas Ulrich[1], Stephan Wawoczny[1], Michael Willers[1], and Andreas Zöller[1] — [1]Technische Universität München, Physik Department Lehrstuhl E15, James-Franck-Straße 1, D-85748 Garching — [2]Excellence Cluster Universe, Boltzmannstraße 2, D-85748 Garching

There is a common need in Astroparticle experiments such as direct Dark Matter detection, for detectors with a very low energy threshold. By employing the Neganov-Trofimov-Luke Effect (NTLE) the thermal signal of photons interacting in a semiconductor absorber, operated at cryogenic temperatures, can be amplified by drifting electrons and holes in an electric field. One of the main problems with such detectors arises from an incomplete and unreliable charge collection. In this work a novel electrode geometry designed to improve the charge collection efficiency is investigated in NTLE detectors and first highly promising results will be presented – this design allows a complete charge collection and provides an outstanding energy resolution. This research was supported by the DFG cluster of excellence Origin and Structure of the Universe and by the Maier-Leibnitz-Laboratorium (Garching).