T 107: Suche nach Dunkler Materie 3

Zeit: Dienstag 16:45–19:05 Raum: HSZ-103

T 107.1 Di 16:45 HSZ-103

Das EURECA Projekt: Status und Perspektiven — •Klaus Eitel für die EURECA-Kollaboration — Karlsruher Institut für Technologie, Institut für Kernphysik, Postfach 3640, 76021 Karlsruhe

Ziel von EURECA (European Underground Rare Event Calorimeter Array) ist die direkte Suche nach Dunkler Materie mit einer Sensitivität auf Wirkungsquerschnitte von $< 10^{-11}$ pb für die spin-unabhängige Streuung von WIMPs an Nukleonen. Dies soll mit einem Feld von kryogenen Bolometern mit einer Gesamtmasse von 1 Tonne auf der Basis der in EDELWEISS und CRESST entwickelten Detektortechnologien erreicht werden. Ein möglicher Standort für EURECA ist das Untergrundlabor LSM, dessen Erweiterung vor kurzem beschlossen wurde. In diesem Vortrag wird die aktuelle Planung auf der Basis des fertiggestellten Conceptual Design Reports vorgestellt. Neueste Detektorentwicklungen, das Abschirmkonzept wie auch die Strategie, eine Untergrundrate von < 1 Ereignis/Tonne/Jahr zu erreichen, werden präsentiert. Eine Übersicht über laufende Arbeiten wird gegeben.

Gefördert durch das BMBF (Verbundforschung Astroteilchenphysik 05A11VK2) und durch die Helmholtz-Allianz für Astroteilchenphysik HAP, ein Instrument des Impuls- und Vernetzungsfonds der Helmholtz-Gemeinschaft.

T 107.2 Di 17:00 HSZ-103

The EURECA Active Shielding Concept — •Geertje Heuermann for the EURECA-Collaboration — Karlsruher Institut für Technologie, Institut für Kernphysik, Postfach 3640, 76021 Karlsruhe

EURECA (European Underground Rare Event Calorimeter Array) is a future experiment for the direct search of dark matter using cryogenic detectors with a total mass of up to 1 ton. The goal of the EURECA experiment is to reach a sensitivity of 10^{-11} pb or below for the cross section of spin-independent WIMP-nucleon interaction. This requires an unprecedented suppression of the background in the nuclear recoil band down to < 1 event/ton/year in the region of interest. External and internal shielding together with an active veto system have to be installed to suppress multiple sources of background. Among them, a potential source are high-energy muons which induce particle showers including energetic neutrons. At present, an 8 m diameter water tank, suggested as a massive shield around the cryostat, is expected to be instrumented with several tens of PMTs detecting Cherenkov light from muons and muon-induced cascades. In this talk we focus on the specific design of the water Cherenkov detector for EURECA and show first results of Monte Carlo studies optimizing its setup.

This work is supported in part by the German ministry of science and education (BMBF Verbundforschung Astroteilchenphysik 05A11VK2).

T 107.3 Di 17:15 HSZ-103

Investigation of Neganov-Luke amplified cryogenic light-detectors for CRESST & EURECA — Andreas Ertl, Achim Gütlein, Jean-Côme Lanfranchi, Andrea Münster, Walter Potzel, Sabine Roth, Daniel Simon, Stephan Scholl, Moritz von Sivers, Raimund Strauss, Stephan Wawoczny, •Michael Willers, Marc Wüstrich, and Andreas Zöller — Technische Universität München, Physik Department E15, James Franck Straße, 85748 Garching

Experiments for the direct detection of dark matter which employ the phonon-light technique like CRESST and the planned experiment EURECA rely heavily on the separation of the different nuclear-recoil bands at low energies for their background suppression. The CRESST experiment uses scintillating CaWO4 crystals as a target in the search for coherent WIMP-nucleon scattering. In the case of electron recoils, about 1% of the energy deposited in a CaWO4 crystal is detected as scintillation light in a separate cryogenic light-detector. For nuclear recoils the scintillation light is further quenched which motivates the need for very sensitive light-detectors. Neganov-Luke amplified cryogenic light-detectors offer a promising way to increase the sensitivity of cryogenic light-detectors by drifting photon induced electrons and holes in an applied electric field and thus amplifying the resulting phonon signal. This research was supported by the DFG cluster of excellence “Origin and Structure of the Universe”, the DFG “Transregio 27: Neutrinos and Beyond”, the “Helmholtz Alliance for Astroparticle Phyiscs” and the “Maier-Leibnitz-Laboratorium” (Garching).

T 107.4 Di 17:30 HSZ-103

Herstellung und Charakterisierung supraleitender Phasenübergangsthermometer für CRESST & EURECA — •Andreas Ertl, Achim Gütlein, Jean-Côme Lanfranchi, Andrea Münster, Walter Potzel, Sabine Roth, Daniel Simon, Stephan Scholl, Moritz von Sivers, Raimund Strauss, Stephan Wawoczny, Michael Willers, Marc Wüstrich und Andreas Zöller — Technische Universität München, Physik Department E15, James Franck Straße, 85748 Garching

Das CRESST Experiment zur direkten Suche nach Dunkler Materie verwendet Tieftemperaturdetektoren ausgestattet mit supraleitenden Phasenübergangsthermometern zum Nachweis von Teilchenwechselwirkungen. Derzeit kommen im Experiment Thermometer bestehend aus einer α-Wolframschicht mit einer typischen Sprungtemperatur von etwa 10mK - 20mK zum Einsatz. Auch Doppelschichtsysteme bestehend aus Iridium und Gold, bei denen sich die Sprungtemperatur über den sogenannten Proximity-Effekt einstellen lässt, bieten einen interessanten Ansatz. Speziell für das Folgeexperiment EURECA, welches etwa 1 Tonne an Targetmasse aufweisen wird, ist die Massenherstellung und Charakterisierung von Phasenübergangsthermometern mit möglichst scharfem Übergang bei einigen zehn Millikelvin essentiell. Erste Arbeiten in diesem Kontext sollen hier vorgestellt und diskutiert werden. Diese Arbeit wurde unterstützt durch den DFG Cluster of Excellence “Origin and Structure of the Universe”, den DFG Transregio 27: “Neutrinos and Beyond”, die Helmholtz Alliance for Astroparticle Phyiscs und das Maier-Leibnitz-Laboratorium Garching.

T 107.5 Di 17:45 HSZ-103

Background investigations for the observation of Coherent Neutrino Nucleus Scattering — •Achim Gütlein, Dominikus Hellgartner, Jean-Côme Lanfranchi, Randolph Möllenberg, Andrea Münster, Lothar Oberauer, Walter Potzel, Sabine Roth, Daniel Simon, Stefan Scholl, Moritz von Sivers, Raimund Strauss, Stefan Wawoczny, Michael Willers, Marc Wüstrich, and Andreas Zöller — Technische Universität München, Physik Department, E15

Coherent Neutrino Nucleus Scattering (CNNS) is a neutral current process where a neutrino scatters off a target nucleus via the exchange of a virtual Z^0 boson. For low transferred momenta the wave length of the Z^0 is comparable to the diameter of the nucleus. Thus, the neutrino scatters coherently off all nucleons leading to an enhanced cross section.

For the first observation of CNNS a strong neutrino source as well as a good background suppression is needed. The expected neutrino count rates for an experiment in the vincinity of a nuclear power reactor will be presented. Also the results of several background simulations and an estimation of the observation potential for an experiment using low-temperature detectors is discussed.

This work has been supported by funds of the Deutsche Forschungsgemeinschaft DFG (Transregio 27: Neutrinos and Beyond), the Excellence Cluster (Origin and Structure of the Universe) and the Maier-Leibnitz-Laboratorium (Garching).

T 107.6 Di 18:00 HSZ-103

PMT series tests for the XENON1T Water Cherenkov Muon Veto — •Christopher Geis for the XENON-Collaboration — Institute of Physics, Johannes Gutenberg-Universität, Mainz, Germany

The XENON1T experiment will achieve a sensitivity for the spin-independent WIMP-nucleon elastic scattering cross section of $2 \cdot 10^{-47}\,\mathrm{cm}^2$ for the direct detection of Dark Matter, requiring a background reduction of two orders of magnitude compared to its predecessor XENON100.

Background consists of neutrons induced by cosmic ray muons penetrating the rock of the LNGS Underground laboratory, where the experiment will be located. Neutrons hitting the detector produce WIMP like signals. They can be vetoed during the passage of their parent muon through a $750\,\mathrm{m}^3$ Water Cherenkov Muon Veto surrounding the detector. To exploit the water as a Cherenkov medium the system will be equipped with R5912 high quantum efficiency 8 " Photomultipliertubes (PMTs) by Hamamatsu detecting the produced Cherenkov light.

84 PMTs will be arranged equally spaced in rings located at the top, bottom and lateral area of the water tank. To inspect the functionality

of each PMT successive tests of their characteristics have to be performed, including estimation of basic parameters like dark rate and gain, as well as more in-depth properties like the number and position of afterpulses, caused by gaseous impurities in the PMTs evacuated glass bulb. We provide an overview of the Muon Veto system and the PMT performances.

T 107.7 Di 18:15 HSZ-103

Efficiency Measurements of a Pre-Seperation Stage for the Krypton Distillation column for the XENON1T experiment — •Stephan Rosendahl[1], Ethan Brown[1], Ion Cristescu[2], Alexander Fieguth[1], Christian Huhmann[1], Michael Murra[1], and Christian Weinheimer[1] — [1]Institut für Kernphysik, Universität Münster — [2]Karlsruher Institut für Technologie, KIT

The XENON1T experiment is the next generation experiment for the direct detection of dark matter in the form of Weakly Interacting Massive Particles (WIMPS). For this purpose a dual-phase TPC, filled with xenon is used, aiming for a fiducial volume of 1 ton to increase the sensitivity to WIMP-nucleon cross section by two orders of magnitude comparing to current experiments. One dominant radioactive contamination, which one needs to reduce to reach the sensitivity, is Kr-85, which has a beta-becay with an endpoint energy of 687keV. Therefore, the xenon has to be purified to a concentration of $<$0.5ppt (parts per trillion) natural krypton in xenon. For this purpose the technique of cryogenic distillation is used. In the distillation column, which is being constructed, the xenon is liquefied in a first condensing station, before it is injected to the distillation tube. This condensing station can be used as a pre-seperation station, to enhance the performance of the system. In this talk the determination of the pre-seperation efficiency and the impact on the design of a distillation column is presented.

Different aspects of this project have been funded by DFG-Großgeräte, BMBF and Helmholtz-Alliance for Astroparticle Physics HAP.

T 107.8 Di 18:30 HSZ-103

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

In the last years, dual phase noble gas detectors like XENON100 or WARP delivered today's most accurate limits on WIMP-nucleon cross-sections up to $\sigma \simeq 10^{-45}\text{cm}^2$. To push the sensitivity to the region of theoretical predicted limits of $\mathcal{O}(10^{-47}\text{cm}^2)$, several European 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. In case of a WIMP colliding with an *Ar* or *Xe* nucleus, photons and electrons will be emitted within the liquid detector material. Whereas photosensors detect the light signal, the electrons drift within a homogeneous electric field, generated by field forming wire electrodes, to the top of the detector to be registered via electroluminescence. This principle allows an excellent background discrimination. In order to map the interaction point correctly, it is indispensable to simulate the exact electric field configuration. Therefore, the simulation program Kassiopeia, originally developed for the KATRIN experiment, has been applied. Kassiopeia uses the Boundary Element Method, which is advantageous especially for simulating fields of geometries consisting of small scale electrodes within large volumina. The talk discusses several calculation methods and summarizes current results.

Gruppenbericht T 107.9 Di 18:45 HSZ-103

An InGrid based Detector for the CAST Experiment — •Christoph Krieger, Klaus Desch, Jochen Kaminski, and Michael Lupberger — Physikalisches Institut, Universität Bonn, Nußallee 12, 53115 Bonn

Micropattern gaseous detectors like Micromegas are used in many particle physics experiments. To make use of the high granularity of Micromegas one has to combine them with a readout structure of comparable granularity. One possibility for this is to produce a Micromegas structure directly on top of a highly granular and integrated pixel chip, e.g. the Timepix ASIC, by means of photolithographic postprocessing. Such an integrated Micromegas stage is called InGrid.

The CAST experiment (Cern Axion Solar Telescope) is searching for solar axions converting into X-ray photons inside a strong magnetic field. Since the expected event rate is very low, an X-ray detector which is able to efficiently differentiate X-ray photons from background events like cosmic ray tracks is necessary. The high resolution of InGrid detectors facilitates an eventshape analysis to improve the background reduction.

An InGrid based X-ray detector is being developed which shall replace one of the CAST detectors. With a prototype detector an energy resolution of 5.2% at 5.9 keV as well as a low background level could be achieved. In this talk recent results as well as the status of the developments will be presented.