T 108: Niederenergie-Neutrinophysik/Suche nach Dunkler Materie 3

Zeit: Dienstag 16:45–19:05 Raum: ZHG 102

Gruppenbericht T 108.1 Di 16:45 ZHG 102

Latest results from the CRESST-II Dark Matter Search — •Raimund Strauss for the CRESST-Collaboration — Physik-Department E15, Technische Universität München, D-85747 Garching, Germany

CRESST-II is searching for Dark Matter WIMPs via elastic scattering off atomic nuclei in scintillating $CaWO_4$ target crystals. CRESST has completed more than 730 kg days of data taking in 2011.

The CRESST target crystals are operated as cryogenic calorimeters at millikelvin temperatures and read out by transition edge sensors. Each interaction in $CaWO_4$ produces a phonon signal in the target crystal and also a light signal that is measured by a secondary cryogenic calorimeter, allowing a very efficient discrimination between electron recoils from radioactive e/γ background and nuclear recoils. Moreover, to some extent, the different types of recoiling nuclei (O, Ca, W) can be distinguished.

We will report on the latest data, collected with eight detector modules. The data has shown a considerable number of events in our signal region. Since this large number of events is not consistent with the known sources of background in our experiment, we will discuss the compatibility of this excess of events with a possible WIMP-signal. Furthermore we will present the several improvements aimed at a reduction of the overall background level which are being implemented for the next data taking.

T 108.2 Di 17:05 ZHG 102

In Situ Determination of Quenching Factors in Cresst-II — •Andreas Zöller[1], Christian Ciemniak[1], Franz von Feilitzsch[1], Josef Jochum[2], Jean-Come Lanfranchi[1], Walter Potzel[1], Franz Pröbst[3], Stefan Schönert[1], Stephan Scholl[2,3], Raimund Strauss[1], and Stephan Wawoczny[1] — [1]Technische Universität München, Physik Department E15 — [2]Eberhard Karls Universität Tübingen — [3]Max Planck Institut für Physik, München

The CRESST-II experiment is searching for WIMPs (Weakly Interacting Massive Particles) via their elastic scattering off nuclei in scintillating $CaWO_4$ single crystals at low temperatures. Each particle interaction in $CaWO_4$ produces a phonon as well as a light signal. The ratio between the recorded light and phonon signal - the Quenching Factor (QF) - is a crucial parameter to discriminate very efficiently between electron recoils from radioactive e/γ background and nuclear recoils, e.g. WIMP events. Moreover, to some extent, the different types of recoiling nuclei (O, Ca, W) can be distinguished, if the QF's are known accurately enough. The QF cannot only be extracted from dedicated experiments but also from calibration data, gathered with an AmBe-source placed inside and outside the neutron shielding of CRESST-II. In this talk we present a method to determine the QFs of $CaWO_4$ in situ from these calibration data. Furthermore, first results will be shown, discussed and compared to other measurements.

This work has been supported by the cluster of excellence “Origin and Structure of the Universe”, the SFB-TR27 and the Maier-Leibnitz-Laboratorium.

T 108.3 Di 17:20 ZHG 102

Blind CRESST Data Analysis in the light of Time-Dependent Noise — •Florian Reindl for the CRESST-Collaboration — Max-Planck-Institut für Physik, D-80805 München, Germany

The CRESST (Cryogenic Rare Event Search with Superconducting Thermometers) experiment directly searches for WIMP Dark Matter (Weakly Interacting Massive Particles). CRESST aims to detect the WIMPs via their elastic scattering off nuclei. Scintillating $CaWO_4$ crystals, operated at mK temperatures, are used as target material. A nuclear recoil mainly excites phonons in the target crystal. Furthermore, a small fraction of the deposited energy is converted into scintillation light. Therefore, each target crystal is paired with a light absorber. The warming-up of the crystal and the light absorber are measured with separate superconducting thermometers. The resulting thermal pulse is used to determine the energy of the corresponding particle interaction by reconstructing the amplitude of the pulse. This reconstruction is done by performing a fit with a so-called standard pulse. A cut on the root mean square (RMS) of this fit, which is a measure of the deviation of the standard pulse and the pulse induced by the interacting particle, is needed to reject pulses which do not guarantee a correct determination of the amplitude and thereby the energy. However, the RMS is energy-dependent and is sensitive to time-dependent noise. This contribution will present a newly developed method to automatically handle both dependencies and thus allowing to perform a completely blind raw data analysis.

T 108.4 Di 17:35 ZHG 102

Ab Initio Cosmogenic Background Simulation for the CRESST – II Experiment — •Stephan Scholl[1], Josef Jochum[1], and Franz Pröbst[2] — [1]Kepler Center for Astro and Particle Physics, Tübingen — [2]Max–Planck–Institut für Physik, München

Today, background induced by cosmogenic neutrons is an important contribution limiting the sensitivity in direct Dark Matter searches like the CRESST – II experiment. As the investigation of the signature of background events becomes more involved, the simulation of the cosmogenically produced neutrons is not sufficient for this task anymore, instead simulations starting from primary muons are required.

In this contribution, such a GEANT4 simulation of primary muons is presented for the CRESST – II experiment at the LN Gran Sasso laboratory which recently reported the observation of an excess signal. The results of this simulation are used to address questions regarding the efficiency of the muon veto, the expected rate of background events and the morphology of cosmogenically induced events.

For events coincident with a hit in the muon veto, the simulation can reproduce the experimentally observed rate and detector hit multiplicity very well.

Having established the agreement between simulation and experiment for events tagged by the muon veto, the disagreement for the simulated non – coincident events and the excess signal seen in the CRESST – II experiment points to the conclusion that another explanation than cosmogenic neutrons must be found for the excess signal.

T 108.5 Di 17:50 ZHG 102

Detector development and background estimation for the observation of Coherent Neutrino Nucleus Scattering (CNNS) — •Achim Gütlein, Christian Ciemniak, Franz von Feilitzsch, Jean-Côme Lanfranchi, Lothar Oberauer, Walter Potzel, Sabine Roth, Stefan Schönert, Moritz von Sivers, Raimund Strauss, Stefan Wawoczny, Michael Willers, and Andreas Zöller — Technische Universität München, Physik-Department, E15

The Coherent Neutrino Nucleus Scattering (CNNS) is a neutral current process of the weak interaction and is thus flavor independent. A low-energetic neutrino scatters off a target nucleus. For low transferred momenta the wavelength of the transferred Z^0 boson is comparable to the diameter of the target nucleus. Thus, the neutrino interacts with all nucleons coherently and the cross section for the CNNS is enhanced.

To observe CNNS for the first time we are developing cryogenic detectors with a target mass of about 10 g each and an energy threshold of less than 0.5 keV. The current status of this development will be presented as well as the estimated background for an experiment in the vincinity of a nuclear power reactor as a strong neutrino source.

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 108.6 Di 18:05 ZHG 102

Status und erste Resultate des EDELWEISS-3 Experiments zur Suche nach Dunkler Materie — •Benjamin Schmidt für die EDELWEISS-Kollaboration — Karlsruher Institut für Technologie, Institut für Experimentelle Kernphysik, Postfach 3640, 76021 Karlsruhe

Das EDELWEISS Experiment verwendet massive kryogene Ge-Bolometer, um im Untergrundlabor von Modane Rückstöße schwach wechselwirkender Teilchen (WIMPs) nachzuweisen. Zur verlässlichen Detektion dunkler Materie und zur Unterdrückung von Elektronrückstößen wird der Energieeintrag des stoßenden Teilchens als Wärmesignal über einen NTD-Thermistor und das Ionisationssignal über Al-Ringelektroden ausgelesen. In der Messperiode 2009/2010 wurde mit dieser Technologie eine der weltweit besten Sensitivitäten von $\sigma_{SI} = 5\cdot10^{-44}\,\mathrm{cm}^2$ bei $m_\chi = 80\,\mathrm{GeV/c}^2$ erreicht [PLB 702 (2011)]. Im Vergleich zu den 10 Detektoren mit je 400 g Masse (ID400) dieser Messperiode werden in EDELWEISS-3 bis Ende 2012 40 Detektoren mit je

800 g (FID800) installiert. Darüber hinaus wird die Abschirmung verbessert sowie die Datenauslese modifiziert, sodass eine Erhöhung der Sensitivität um einen Faktor 10 erreicht werden kann. Der Status der Umbauarbeiten sowie erste Resultate mit den FID800-Detektoren werden vorgestellt und ein Ausblick auf das EUERECA-Projekt 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 108.7 Di 18:20 ZHG 102

Pulsformanalyse und Datenverarbeitung für die Dark Matter Suche in EDELWEISS — •Michael Unrau für die EDELWEISS-Kollaboration — Karlsruher Institut für Technologie, Institut für Experimentelle Kernphysik, Postfach 3640, 76021 Karlsruhe

Die bei der bolometrischen Dark Matter Suche zu erwartenden Kernrückstöße verursachen eine Temperaturänderung im Bereich von einigen μK bei einem Arbeitspunkt von $18mK$. Die Auflösung der Messdaten ist entscheidend für die zuverlässige Trennung von Signal und Untergrund. Um ausreichend hohes Auflösungsniveau zu erreichen, müssen bei einer Samplingfrequenz von $100KS/s$ die im Vergleich dazu relativ langen Detektorpulse ($\tau_{decay} \sim 100ms$) deutlich vom Rauschen unterschieden werden. Zu diesem Zweck wurde eine spezielle Pulsformanalyse entwickelt und in das Datenanalyseprogramm KData integriert. Die auf ROOT basierende Datenstruktur erlaubt einen einfachen Zugriff auf die volle Signalinformation sowie die Integration von weiteren Systemen wie z.B. ein Myon-Veto. Außerdem bietet KData einen Backend für die automatisierte Verarbeitung der Messdaten. In diesem Vortrag soll die Pulsformanalyse und das Datenmanagment näher vorgestellt werden.

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 108.8 Di 18:35 ZHG 102

Indirekte Suchen nach supersymmetrischer Dunkler Materie mit dem IceCube-Neutrinoteleskop und Ausschlussmöglichkeiten im pMSSM-Kontext — •Klaus Wiebe — Institut für Physik, Universität Mainz

Der Vortrag wird kurz das indirekte Detektionsprinzip zerstrahlender supersymmetrischer DM-Kandidaten mit dem IceCube-Detektor erläutern und im Hauptteil Scans des 25-Parameter-pMSSM-Modells behandeln, insbesondere Ausschlussgrenzen auf den Parameterraum durch IceCube und Vergleiche mit den Limits direkter Suchen und des LHC.

T 108.9 Di 18:50 ZHG 102

Neutrino mass determination utilizing high precision measurements of the ^{163}Ho electron capture spectrum — •P. Ranitzsch, J.-P. Porst, S. Schäfer, S. Kempf, C. Pies, N. Foerster, D. Hengstler, S. Uhl, T. Wolf, A. Fleischmann, C. Enss, and L. Gastaldo — Kirchhoff-Institute for Physics, Heidelberg University

The absolute scale of the neutrino mass eigenstates is one of the puzzles in modern particle physics and can be directly investigated using electroweak decays. In the context of the ECHO collaboration we are developing low temperature metallic magnetic calorimeters (MMCs) to be used with an internal ^{163}Ho source to measure its electron capture spectrum.

MMCs are calorimetric particle detectors operated below 100 mK based on a paramagnetic temperature sensor, that convert the temperature rise due to the absorption of an energetic particle to a change of magnetization which is detected by a SQUID magnetometer. These detectors fulfill the requirements for cryogenic neutrino mass investigations, namely an energy resolution ΔE_{FWHM} below 2 eV and pulse formation times of $\tau < 1\,\mu$s. $\Delta E_{\mathrm{FWHM}} = 2.0\,$eV and $\tau = 90\,$ns have been observed in micro-fabricated MMCs for soft X-ray detection.

We outline the scientific goals and the contributions of the participating groups of the recently formed ECHO collaboration. We present results obtained with a first detector prototype using a Au absorber with ^{163}Ho ions implanted at ISOLDE(CERN). The achieved energy resolution of $\Delta E_{\mathrm{FWHM}} = 12\,$eV and rise times of $\tau = 90\,$ns are very promising results and encourage further investigation.