HK 57: Astroparticle Physics 3

Time: Thursday 17:00–18:45 Location: K/HS1

Group Report HK 57.1 Thu 17:00 K/HS1

Nuclear currents for WIMP-nucleus scattering based on chiral effective field theory⋆ — •Philipp Klos[1,2], Javier Menéndez[1,2,3], and Achim Schwenk[1,2] — [1]Institut für Kernphysik, Technische Universität Darmstadt — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH — [3]The University of Tokyo

Interactions of nuclei with external probes are crucial for understanding various new physics processes. The nuclear currents involved can be described in the framework of chiral effective field theory, which provides a consistent treatment of both nuclear forces and currents based on the same chiral Lagrangian. We include the currents at the one-body level and the leading two-body currents, which we have derived for axial-vector currents at finite momentum transfers for the first time. As an application we will present results for spin-independent and spin-dependent structure factors for WIMP-nucleus scattering necessary for the evaluation of dark matter experiments.

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Group Report HK 57.2 Thu 17:30 K/HS1

Status and first data of the EDELWEISS-III experiment — •Silvia Scorza for the EDELWEISS-Collaboration — Karlsruher Institut für Technologie, Institut für Experimentelle Kernphysik, Postfach 3640, Karlsruhe

The EDELWEISS-III collaboration is operating an experiment for the direct detection of Weakly Interacting Massive Particle (WIMPs) dark matter in the low radioactivity environment of the Modane Underground Laboratory. It consists of 36 advanced FID germanium detectors operating at 18 mK in a dilution refrigerator in order to identify eventual rare nuclear recoils induced by elastic scattering of WIMPs from our Galactic halo. I will discuss the current EDELWEISS-III program, including improvements of the background, data-acquisition and the current installation. FID detector performances and a first analysis of data acquired in a long-term campaign will be presented. The FID detector technology is not limited to EDELWEISS-III but can be further employed in the next generation of cryogenic detector experiments.

HK 57.3 Thu 18:00 K/HS1

Displaying results of direct detection dark matter experiments free of astrophysical uncertainties — •Ludwig Rauch and XENON100 Collaboration — Max Planck Institut für Kernphysik, Heidelberg

A number of experiments try to measure WIMP interactions by using different detector technologies and target elements. Hence, energy thresholds and sensitivities to light or heavy WIMP masses differ. However, due to large systematic uncertainties in the parameters defining the dark matter halo, a comparison of detectors is demanding. By mapping experimental results from the traditional cross section vs. dark matter mass parameter-space into a dark matter halo independent phase space, direct comparisons between experiments can be made. This is possible due to the monotonicity of the velocity integral which enables to combine all astrophysical assumptions into one parameter common to all experiments. In this talk the motivation as well as the mapping method will be explained based on the XENON100 data.

HK 57.4 Thu 18:15 K/HS1

Photomultiplier tests for XENON1T — •Dominick Cichon on behalf of the XENON collaboration — Max-Planck-Institut für Kernphysik, Heidelberg, Germany

The upcoming dark matter direct-detection experiment XENON1T will employ photosensors with high detection efficiencies and low intrinsic radioactivity. This is necessary for the experiment to reach its projected sensitivity to interaction cross sections down to $\sigma \sim 2 \cdot 10^{-47} \mathrm{cm}^2$ fo the case of a dark matter particle with mass $\sim 50 \mathrm{GeV/c}^2$ interacting with a nucleon.

This talk illustrates how photomultiplier tubes (PMTs) for XENON1T are tested in order to decide whether they fulfill the experiment's requirements. The general testing procedure will be outlined, with a focus being placed on PMT testing facilities at the MPIK in Heidelberg used for this task, where PMT properties at room temperature and at liquid xenon temperature are measured.

HK 57.5 Thu 18:30 K/HS1

Removal of noble gases out of xenon by a cryogenic distillation column for the XENON1T experiment — •Alexander Fieguth, Michael Murra, Stephan Rosendahl, Gianmarco Bruno, Sergej Schneider, Christian Weinheimer, and Christian Huhmann — Institut für Kernphysik, WWU Münster

The upcoming XENON1T experiment is the next step for the dark matter particle search. It will surpass current limits on the WIMP-nucleon cross section set by liquid xenon detectors as LUX and XENON100 by more than an order of magnitude, which leads to an expected sensitivity of $2.0 * 10^{-47}$ cm^2 for WIMPs with a mass of 50 GeV/c^2 after a 2.2 ton-year live-time. For achieving new sensitivity limits the reduction of internal background sources as ^{85}Kr and ^{222}Rn is of crucial importance. Taking advantage of the different boiling points of these noble gas impurities and xenon, they can be separated by a cryogenic distillation column in different steps. The improvement of the krypton removal by distillation for the XENON1T experiment and a first test setup on radon distillation at the XENON100 experiment will be presented. Different aspects of this project have been funded by DFG-Großgeräte, BMBF and Helmholtz-Alliance for Astroparticle Physics (HAP).