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Rare event searches with cryogenic detectors - COSINUS, CRESST and NUCLEUS

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Recently the coherent scattering of neutrinos off nuclei (CNNS) was experimentally proven. The signal characteristics are very similar to the anticipated scatterings of dark matter particles off nuclei. In particular both share a recoil spectrum steeply falling with energy and ending at maximally a few keV. Thus, also the experimental requirements are similar: a low energy threshold for nuclear recoils combined with background suppression. Cryogenic detectors meet both requirements. The CRESST direct dark matter search achieved a threshold of 30eV in 24g CaWO4-crystals pushing the sensitivity of direct detection experiments down to 160MeV. COSINUS uses the same readout technology, but aims to perform a cross-check of the long-standing dark matter claim by the DAMA/LIBRA. They observe an annual modulation of the event rate which agrees in period and rate with the expectation for dark matter. To make the cross-check model-independent, COSINUS uses - like DAMA/LIBRA - NaI crystals as target material, but COSINUS operates them as scintillating cryogenic calorimeters. This operating mode not only provides a lower nuclear recoil threshold, but also yields particle identification on event-by-event basis, both unique features for NaI-based detectors. NUCLEUS is another application of CRESST technology and uses miniaturized CaWO4 or Al2O3 detectors to study CNNS at very low recoil energies O(10eV) which allows precision test of the Standard Model (e.g. Weinberg angle and neutrino magnetic dipole moment) and also the search for non-standard interactions. The working principle of cryogenic scintillating calorimeters will be presented, as well as the physics cases and current status of the three experiments.

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