Exploring CEvNS at the 100 eV Frontier with the NUCLEUS Experiment

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Coherent elastic neutrino-nucleus scattering (CEvNS) offers a unique way to study neutrino properties and to search for new physics beyond the Standard Model. The NUCLEUS experiment aims to measure CEvNS of reactor anti-neutrinos down to unprecedented low nuclear recoil energies. The gram-scale cryogenic detectors feature an ultra-low energy threshold of ~20 eV. The experiment will be located at a new experimental site at the Chooz nuclear power plant in France, providing a high anti-neutrino flux of 1.7 · 1012 ν /(s · cm2). Thanks to the large CEvNS cross-section, the low-energy threshold, and the high neutrino flux, a target of 10 g CaWO4 and Al2O3 crystals is sufficient to provide a detectable neutrino interaction rate.

NUCLEUS is currently being assembled and commissioned at the Technical University of Munich. We recently reported the first observation of a nuclear recoil peak around 112 eV induced by thermal neutron capture. This measurement demonstrates a new calibration method for CEvNS and light Dark Matter (DM) experiments, which will become essential for finding and studying new physics. In this talk, I will review the physics potential of NUCLEUS and its current status. Furthermore, I will highlight the possibility and potential of a precision calibration of nuclear recoils in materials used in CEvNS and DM experiments based on thermal neutron capture.