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CRAB: Calibration of bolometers for nuclear recoils at the 100 eV scale using neutron capture

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Cryogenic detectors have reached low-threshold and high energy resolution, making them useful tools to detect sub-keV nuclear recoils induced by Coherent Elastic Neutrino-Nucleus Scattering, or interactions with light Dark Matter. However, these detectors lack calibration for nuclear recoils at this energy scale. The CRAB method proposes to use nuclear recoils produced by gamma de-excitation after thermal neutron capture in the cryogenic detector to provide calibration peaks in the region of interest. In particular, single-gamma transitions of several MeV induce well-defined nuclear recoil peaks in the 100eV-1keV range. CRAB is so far the only calibration method offering pure nuclear recoils in the bulk of the detector, and at this energy range.

Combining GEANT4 Monte-Carlo simulations, and gamma de-excitation predictions from the FIFRELIN code, we have studied the expected energy spectrum in various cryogenic detectors widely used in the community. Currently in the R&D phase, the CRAB project intends on calibrating cryogenic detectors near the low power TRIGA reactor in Vienna. Simulations show that $CaWO_4$ is a material with two nuclear recoil peaks at 112.5eV and 160.3eV that should stand out well above the multi-gamma recoil continuum. Detecting the emitted gamma in coincidence with the subsequent nuclear recoil in the cryogenic detector is expected to increase the sensitivity of the CRAB method, extending its application to other materials, such as germanium or silicon, and possibly to lower recoil energies. Latest simulation results and experimental strategy will be discussed.

In-person participation

Yes

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