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Feasibility of $\text{CE}\nu\text{NS}$ Search at APSARA-U

Coherent Elastic Neutrino Nucleus Scattering (CE ν NS) offers exciting opportunities to probe new physics within and beyond the Standard Model. The process occurs when the scattering amplitudes of nucleons interfere constructively, leading to the scattering of the entire nucleus. Detecting CE ν NS provides deeper insights into neutrino properties, such as the neutrino magnetic moment, millicharge, and potential new force mediators. CE ν NS enables the exploration of the neutrino spectrum below approximately 1.8 MeV, a region inaccessible through Inverse Beta Decay. Studying CE ν NS also sheds light on the neutrino fog, an irreducible background for Dark Matter searches.

Despite the enhanced cross-section of $\text{CE}\nu\text{NS}$ compared to other neutrino interactions, $\text{CE}\nu\text{NS}$ signals are challenging to detect due to their low recoil energy up to $\mathcal{O}(\text{keV})$. However, cryogenic dark matter detectors, with thresholds in the $\mathcal{O}(10\text{ eV} - 100\text{ eV})$ range and excellent energy resolutions around $\mathcal{O}(10\text{ eV})$, are sensitive enough to measure these small recoil signals. Reactor facilities, with their abundant neutrino flux in the $\mathcal{O}(\text{MeV})$ range, provide an ideal environment for studying $\text{CE}\nu\text{NS}$. At NISER, we are investigating the feasibility of conducting

CE ν NS studies at research reactors, such as the 2 MW APSARA-U. We will present simulation results of background studies and shielding optimization for a cryogenic detector-based experiment at APSARA-U for CE ν NS detection.

Field of contribution

Experiment

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