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Probing the Neutrino-Nucleus Elastic Scattering with Point Contact Germanium detectors and its Quantum-Mechanical Coherency Effects

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Neutrino Nucleus Elastic scattering (νA_{el}) is a well understood Standard Model process. Experimental cross-sections are enhanced and yet complicated by quantum-mechanical coherency effects with their q^2 dependence. Positive measurements of νA_{el} so far were achieved by the COHERENT experiment with stopped pion neutrinos (E_ν<53 MeV). The TEXONO experiment is pursuing measurement of the νA_{el} interactions with the reactor neutrinos (E_ν<10 MeV) at the Kuo-Sheng Reactor Neutrino Laboratory (KSNL) 1, in a kinematic regime where the QM coherency is complete, and hence uncertainties of the nuclear many-body effects are decoupled. Point-contact germanium detectors at sub-keV sensitivities 2 are adopted to detect the low-energy nuclear recoils in νA_{el} . We will report our latest status and plan of this program. A complementing line of research is on the formulation of a universal scheme to quantify the QM coherency effects in νA_{el}, and study their dependence on experimental configurations 3. Constraints from existing and projected measurements 4 are presented.

1 "Research program towards observation of neutrino-nucleus coherent scattering.", H. T. Wong et al., J. Conf. Ser. 39, 266 (2006).
2 "Characterization and performance of germanium detectors with sub- keV sensitivities for neutrino and dark matter experiments.", A. K. Soma et al., Nucl. Inst. and Meth. in Phys. Res. A 836, 67-82 (2016).
3 "Coherency in neutrino-nucleus elastic scattering.", S. Kerman et al., Phys. Rev. D93, 113006 (2016).
4 "Studies of quantum-mechanical coherency effects in neutrino-nucleus elastic scattering.", V. Sharma et al., Phys. Rev. D 103, 092002 (2021).

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