

Snowmass-2021 LOI Survey

Neutrino Physics at the Kuo-Sheng Reactor Laboratory with the TEXONO Research Program – Highlights of Status and Plans

Henry T. Wong (on behalf of the TEXONO Collaboration)

Institute of Physics, Academia Sinica, Taipei 11529, Taiwan.

Contact: htwong@phys.sinica.edu.tw

The TEXONO collaboration has been studying neutrino physics with sub-keV germanium detectors at the Kuo-Sheng Reactor Neutrino Laboratory (KSNL) in Taiwan [1]. There is a national policy of de-commissioning nuclear power in Taiwan, and the Kuo-Sheng Reactor will be phased out by 2023. As a result, there are no plans on expansion or new projects to the KSNL program. The collaboration would seek to continue the studies via collaboration with other existing reactor laboratories.

The current theme at KSNL is on the observation of neutrino-nucleus elastic scattering at the kinematic regime where complete quantum-mechanical coherency is expected [2]. Data taking and R&D program are conducted with electro-cooled (EC) point-contact germanium detectors (PCGe). As of summer 2020, detector mass up to 1.43 kg are built and threshold as low as 200 eV_{ee} is achieved. The data would also bring improved sensitivities to the searches on various Beyond Standard Model (BSM) physics channels, such as neutrino magnetic moments [3] and milli-charged neutrinos [4]. Active theory program is being pursued in parallel, with focuses on atomic corrections to νN (and χN for dark matter) cross-sections [5], as well as BSM searches.

In parallel to the operation at KSNL and conducting its physics research, the TEXONO program is a founding partner of the CDEX experiment at the China Jinping Underground Laboratory (CJPL) [6] using PCGe detectors with sub-keV sensitivities in light WIMP searches. Notable recent results include Migdal effect analysis [7] and searches of annual modulations [8]. The TEXONO group participates in the PIRE-GEMADARC program [9] on R&D on Ge detector techniques for future particle physics experiments, with emphasis on EC-Ge techniques and realization of Ge detector with internal amplification [10]. Senior researchers of TEXONO and CDEX groups are members of the LEGEND program on neutrinoless double beta decay searches in ⁷⁶Ge [11], with focuses on studying the case of hosting a future ton-scale Ge experiment at CJPL. Following the traditions of exploring new experimental domains, the TEXONO team, within the framework of KAGRA collaboration, is involved in new initiatives of developing gravity field based calibration scheme [12] for gravitational wave observatories, with potentials of testing non-Newtonian gravity [13].

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