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Non-standard neutrino interactions in light mediator models at reactor experiments

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Compared to other neutrino sources, the huge anti-neutrino fluxes at nuclear reactor based experiments empower us to derive stronger bounds on non-standard interactions of neutrinos with electrons mediated by light scalar/vector mediators. At neutrino energy around 200 keV reactor anti-neutrino flux is at-least an order of magnitude larger compared to the solar flux. The atomic and crystal form factors of the detector materials related to the details of the atomic structure becomes relevant at this energy scale as the momentum transfers would be small. Non-standard neutrino-electron interactions mediated by light scalar/vector mediator arises naturally in many low-scale models. We also propose one such new model with light scalar mediator. Here, we investigate the parameter space of such low-scale models in reactor based neutrino experiments with low threshold Ge and Si detectors, and find the prospect of probing/ruling out the relevant parameter space by finding the projected sensitivity at 90% confidence level by performing a χ^2-analysis. We find that a detector capable of discriminating between electron recoil and nuclear recoil signal down to very low threshold such as 5 eV placed in reactor based experiment with very low threshold would be able to probe larger region in parameter space compared to the previously explored region. A Ge (Si) detector with 10 kg-yr exposure and 1 MW reactor anti-neutrino flux would be able to probe the scalar and vector mediators with masses below 1 keV for coupling products $\sqrt{g_\nu g_e} \sim 1 \times 10^{-6}$ (9.5×10^{-7}) and 1×10^{-7} (8×10^{-8}), respectively.

Session

Neutrino Physics

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