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Neutrinoless double beta decay and non-standard neutrino interactions in nuclear medium

We discuss a novel effect in neutrinoless double beta decay related with the fact that its underlying mechanisms take place in the nuclear matter environment. We study the neutrino exchange mechanism and demonstrate the possible impact of nuclear medium via Lepton Number Violating (LNV) 4-fermion scalar-type interactions of neutrino with the quarks from decaying nucleus. The net effect of these interactions is generation of an effective in-medium Majorana neutrino mass matrix.

The gradually improving cosmological and single beta decay neutrino mass limits may lead in the future to apparent incompatibility of observation of the neutrinoless double beta decay with the value of the neutrino mass constrained by the single beta decay and cosmological data. In such a case, the new physics would be mandatory. It can be represented, in particular, by the new effective scalar-type TeV scale neutrino-quark interactions enhanced in the neutrinoless double beta decay in the nuclear mean field. If the dominant mechanism of the neutrinoless double beta decay is Majorana neutrino exchange, the scenario which we present here will provide the most direct explanation for the above mentioned possible incompatibility between the experiments.

The effective neutrino masses and mixing are calculated for the complete set of the relevant 4-fermion neutrino-quark operators. Using experimental data on the neutrinoless double beta decay in combination with the single beta decay and cosmological data we evaluate the characteristic scales of the LNV operators (> 2.4 TeV).

Literature:

1. Kovalenko S. , Krivoruchenko M. I., Simkovic F.

Neutrino propagation in nuclear medium and neutrinoless double-beta decay, e-Print: arXiv:1311.4200 [hep-ph], accepted in Phys. Rev. Lett.

Primary author: Prof. SIMKOVIC, Fedor (Comenius University)

Co-authors: Prof. KRIVORUCHENKO, Mikhail (ITEP Moscow); Prof. KOVALENKO, Sergey (Universidad Tecnica Federico Santa Maria)

Presenter: Prof. SIMKOVIC, Fedor (Comenius University)

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