



Contribution ID: 516

Type: Poster

Neutrino decay processes and flavour oscillations

The phenomenon of neutrino oscillations emerges due to coherent superposition of neutrino mass states. An external environment can modify a neutrino evolution in a way that the coherence will be violated. Such violation is called quantum decoherence of neutrino mass states and leads to the suppression of flavor oscillations. In our previous paper [1], we presented a new theoretical framework, based on the quantum field theory of open systems applied to neutrinos. Within this framework we proposed and considered a new mechanism of the neutrino quantum decoherence engendered by the neutrino radiative decay in an electron background in an extreme astrophysical environment. In the present study we generalize our approach and consider neutrino radiative decay accounting for the neutrino magnetic moment and milicharge. We also account for the neutrino decay into a hypothetical scalar particle (that can be a familon or another axion-like particle). We show that such decays can also lead to the neutrino quantum decoherence. Using the experimental constraints on neutrino quantum decoherence [2] we estimate the neutrino decay rates.

[1] K.Stankevich, A.Studenikin, Neutrino quantum decoherence engendered by neutrino radiative decay, Phys. Rev. D 101 (2020) 056004.

[2] J.A.B.Coelho, W.A.Mann, Decoherence, matter effect, and neutrino hierarchy signature in long baseline experiments, Phys. Rev. D 96 (2017) 093009.

This work is supported by the Russian Foundation for Basic Research under grant No. 20-52-53022-GFEN-a. The work of KS is also supported by the Russian Foundation for Basic Research under grant No. 20-32-90107 and by the BASIS Foundation No. 20-2-2-3-1. The work of MV is also supported by the BASIS Foundation No. 20-2-1-25-1.

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Collaboration / Activity

None

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Session Classification: T04: Neutrino Physics

Track Classification: Neutrino Physics