

# Neutrino production, detection and propagation inside matter, beyond the Standard Model (Abstract)

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We would like to check what is the possible impact of a New Physics (NP) for the full neutrino oscillation processes. The NP neutrino interactions can modify (i) the neutrino production, (ii) neutrino propagation in a matter and (iii) their detection process. We assume that the neutrino charge and neutral current interactions are described by the effective model Lagrangian where both vector and scalar, with left and right chirality couplings, are present. All the NP parts of the Lagrangian are multiplied by parameters, which can be bound by existing experimental data, e.g. from the muon decay. Then, we calculate the density matrix of the produced neutrino. Next this density matrix evolves in a matter to a detector place (this evolution describes the neutrino oscillation), and finally, we calculate the cross section for a detection process. Having such full description of the oscillation phenomena we are able to answer many interesting questions, as for example: 1) under which conditions initial neutrino states can be described by pure Quantum Mechanical (QM) states govern by the Maki, Nakagawa and Sakata mixing matrix and how good such approximation is, 2) in which way the mixed QM states influence the neutrino propagation in a matter, 3) whether, and how large, the matter with general properties (e.g. polarization) changes the predictions, 4) is the traditionally used factorization formulae for the final detection rate of any neutrino flavor correct and if not, what kind of approximation it is, and finally, 5) how good is the common approach in which the NP effects are only applied for neutrino propagation in the matter and what we miss neglecting the beyond SM interactions for the neutrino production and detection. Using the simplified neutrino production and detection processes (lepton – nucleon scattering), and propagating neutrino inside medium with the general properties, we present various numerical results which answer the just mentioned questions.

Based on:

- 1) F. del Aguila, J. Syska, M. Zralek; hep-ph/0702.2182; *Impact of right-handed interactions on the propagation of Dirac and Majorana neutrinos in matter*, published in Phys.Rev. D76: 013007, 2007.
- 2) J. Holeczek, J. Kisiel, J. Syska, M. Zralek; hep-ph/0706.1442; *Searching for new physics in future neutrino factory experiments*, published in Eur.Phys.J.C52: 905-917, 2007.
- 3) J. Syska, S. Zając and M. Zralek; *Neutrino oscillation in the case of general interaction*, published in Acta Physica Polonica B.Vol. 38,3365-3371, 2007.
- 4) M. Ochman, R. Szafron, M. Zralek; hep-ph/0707.4089; *Neutrino production states in oscillation phenomena. Are they pure or mixed?*, to appear in J.Phys.G: Nucl.Part. Phys. 35, 2008.
- 5) F. del Aguila, J. Syska, S. Zając and M. Zralek; *Neutrino production, propagation in a matter and detection in the case of general interaction*, in preparation.