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Analytical description of the Earth matter effect on neutrino oscillations

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We present an analytical description of neutrino oscillations in matter based on the Magnus expansion of the time evolution operator. The approximated expressions obtained for the case of two neutrino mixing that propagate in the Earth potential, give considerably better results and in a wider energy range than the perturbative expressions existing in the literature. We apply our formalism to the cases of low and high energy neutrinos which are relevant for the next generation of neutrino detectors.

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