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Time-reversal invariance and neutrino oscillations in a medium with a symmetric density

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We consider the evolution operator of a quantum system described
by a time-dependent Hamiltonian that is invariant under time reversal.
As an illustration we examine the three-neutrino oscillations in a medium
with a density profile which is symmetrical about the midpoint of the of the
neutrino trajectory. The evolution operator is written as the product of factors
corresponding to effective two-neutrino problems for a low and a
high energy regime and each factor determined by means of the
Magnus approximation up to second order. Oscillation probabilities
calculated in this manner for the case of atmospheric neutrinos
traversing Earth show good agreement with numerical calculations.

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