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Neutrino spin oscillations in spatially inhomogeneous magnetic fields of realistic astrophysical objects

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We study neutrino spin and spin-flavor oscillations in spatially inhomogeneous multipolar magnetic fields of realistic astrophysical objects. Starting from the general neutrino electromagnetic interaction Hamiltonian, we derive the effective interaction Hamiltonian for an arbitrarily moving neutrino in a multipolar magnetic field expressed in spherical coordinates. An exact analytic expression for the geometric phase arising from the spatial inhomogeneity of the magnetic field is obtained. For the particular cases of neutrino propagation inside the astrophysical object along radial direction, the resonance conditions and adiabaticity parameters for spin-flip transitions are analyzed in core-collapse supernovae, using realistic magnetic field models and matter density profiles.

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