In the introduction we give a short review of different phenomena of neutrino interactions in the presence of external electromagnetic fields and dense matter (neutrino electromagnetic properties, neutrino oscillations in different environments, neutron beta decay in a magnetic filed and some astrophysical and cosmological applications of these phenomena are discussed).

Then we discuss a quite powerful method in investigations of different phenomena that can appear when neutrinos (and also electrons) propagate in dense matter. The method is based on the use of the modified Dirac equations for particles wave functions in which the correspondent effective potentials account for the matter influence on particles. For several particular cases we have found the exact solutions for particles energy spectra and wave functions in matter. On this basis, such phenomena as neutrino trapping and reflection, neutrino-antineutrino pair annihilation and creation in medium can be considered. With use of the same method a neutrino motion in rotating medium is also discussed. We shown that the neutrino energy spectrum exhibits very exiting properties: neutrino motion in the plane transversal to the matter rotation axes is quantized and can be interpreted as a set of circular orbits very much like the well known Landau levels for an electron moving in a constant magnetic field.

A new mechanism of the electromagnetic radiation that can be emitted by a neutrino or electron when these particles move in a dense medium ("spin light of neutrino" and "spin light of electron", $SL\nu$ and SLe) are also considered within the developed method.

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