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Asymmetry of the neutrino mean free path in hot neutron matter under strong magnetic fields

The neutrino mean free path in neutron matter under a strong magnetic field is evaluated for the inelastic scattering reaction and studied as a function of the neutron matter density in the range $0.05 \leq \rho \leq 0.4$ fm^{-3} for several temperatures up to 30 MeV and magnetic field strengths B=0 G, 10^{18} G and 2.5×10^{18} G. Polarized neutron matter is described within the non–relativistic Brueckner–Hartree–Fock (BHF) approach using the Argonne V18 nucleon-nucleon potential supplemented with the Urbana IX three-nucleon force. Explicit expressions of the cross section per unit volume for the scattering of a neutrino with a spin up or spin down neutron are derived from the Fermi Golden rule. Our results show that the mean free path depends strongly on the angle of the incoming neutrino, leading to an asymmetry in this quantity. This asymmetry depends on the magnetic field intensity and on the density, but it is rather independent of the temperature. For a density of 0.16 fm^{-3} at a temperature T$=$ 30MeV, the asymmetry in the mean free path is found to be of $\sim 15\%$ for B=10^{18}G and $\sim 38\%$ for B=2.5×10^{18}G.

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