SPIN POLARIZATION OF NUCLEONS. LIMITS OF LOW AND HIGH TEMPERATURES

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The problem of spin polarization of nucleons is important in astrophysics for the explanation of magnetic fields of some types of astrophysical objects. At the densities of the order of nuclear saturation density this problem is applied to neutron stars [1], and the results are very model-dependent. At lower densities this problem is applicable to white dwarfs and type II Supernovae.

The magnetic fields of white dwarfs can be explained by magnetic flux conservation at contraction, common envelope and accretion in close binary systems, rotation, hydromagnetic dynamo [2,3], but for white dwarfs with hydrogen envelopes (DAH and DAP white dwarfs) such explanations can be added by spin polarization of protons in outer melted layers.

The magnetic fields of type II Supernovae can be explained by asymmetric collapse with jets and rotation, Rayleigh-Taylor and Kelvin-Helmhottz hydromagnetic instabilities [4], but these explanations can be added by spin polarization of protons and neutrons, though the lifetime of such systems is small [5].

Neutron-proton system with contact nuclear spin-isospin-dependent interaction was considered at densities 2 and more orders lower than nuclear saturation density at high and low temperatures through minimal energy density at finite spin polarization degrees and through Stoner criterion. Stoner criterion was found through the poles of magnetic susceptibility of the system and through the negative sign of energy density fluctuations dependent on spin density fluctuations of nucleons on the basis of the algorithm for 1-component cold Fermi-gas [6]. The importance of Coulomb exchange and correlation energies consideration was shown. Spin polarization initiation was found to be energetically preferable at proton and neutron densities of the orders of 10^{30}-10^{31} cm^{-3} and 10^{35}-10^{36} cm^{-3}. The existence of the first region of densities was shown to be due to Coulomb exchange energy, and the influence of Coulomb correlation energy was shown to be negative.

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