Magnetization of High Density Hadronic Fluid

In the present paper the magnetization of a high density relativistic fluid of elementary particles is studied. At very high densities, such as may be found in the interior of a neutron star, when the external magnetic field is gradually increased, the energy of the normal phase of the fluid remains practically constant before extremely high magnetic fields are reached. However, if pion condensation occurs, the energy decreases linearly while the magnetic field strength increases, so that a non vanishing magnetization, independent of the magnetic field, is present. The expression of the magnetization is derived by first considering and solving the Dirac equation of a fermion in interaction with a magnetic field and with a chiral sigma-pion pair. The solution provides the energies of single-particle states. The energy of the system is found by summing up contributions from all particles in the particle fluid. For nuclear densities above 2 to 3 rho(0), where rho(0) is the equilibrium nuclear density, the resulting magnetic field turns out to be rather huge, of the order of 10(17) Gauss.

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