EFFECTS OF MAGNETIZATION ON STRUCTURE PARAMETERS OF NEUTRON STARS

Q.M. Wang, S.H. Gao
Department of Physics
Beijing Normal University
Beijing, China

We took the magnetic susceptibility χ as a criterion in this study and supposed that the system of neutron matter has a ferromagnetic transition as $1/\chi \to 0$. The magnetic susceptibility of pure neutron matter at zero temperature was calculated by means of Owen's lowest order constraint variation method. The following results were obtained: if the interaction between neutron and neutron was the Reid soft-core potential, then no transition to ferromagnetic state was found to occur; if the interaction was HJ,IY potentials, the neutron matter would undergo a transition. These results indicate that the existence of ferromagnetic state depends on the form of potentials. If the interaction between particles is attractive, it will not profit the existence of ferromagnetic state, while the interaction between neutrons has a repulsive core, it will profit the existence of ferromagnetic state. We also calculated the equation of state and structure parameters of neutron stars. It showed that the energy of ferromagnetic state is lower than that of nonferromagnetic one and the ferromagnetic state is more stable. In other words, the ferromagnetic state may exist in neutron stars. We can readily find that ferromagnetic state has some influence on structure parameters of neutron stars, the magnitude of this effect depends on the form of potentials and the values of these structure parameters with ferromagnetism are within the allowed range. In this paper, the possibility existing the ferromagnetic state has been dsicussed. By a rough estimate, the magnetic field strength coming from the complete ferromagnetic state is about 10^{15} Gauss at $\rho \sim 10^{15}$ g/cm^3. We assume that this is a possible origin of the strong magnetic fields in neutron stars. If there exists a ferromagnetic state in neutron stars, it will have a substantial influence on the gravitaional collapse theory, neutron superfluid and proton superconductivity.

D. J. Helfand and J.-H. Huang (eds.), The Origin and Evolution of Neutron Stars, 451.