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Fermi gas in a magnetic field and related anisotropy in quark stars

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We present the number density, energy density, transverse pressure, longitudinal pressure, and magnetization of an ensemble of spin one-half particles in the presence of a homogenous background magnetic field. The magnetic field direction breaks spherical symmetry causing pressure anisotropy in the system. Explicit expressions for both charged and uncharged particles including the effect of the anomalous magnetic moment at zero and finite temperature are obtained. The resulting expressions satisfy the canonical relations Ω = - P_parallel and P_perp = P_parallel - M B, where M = - ∂Ω/∂B is the magnetization of the system. The pressure anisotropy for a gas of protons and a gas of neutrons are shown. The inclusion of the anomalous magnetic moment increases the level of pressure anisotropy in both cases [1].

Next, we have chosen the MIT bag model and analyzed different stages of magnetized quark star evolution. The first stages of the evolution are simulated through the inclusion of trapped neutrinos and fixed entropy per particle, while in the last stage the star is taken to be deleptonized and cold. Magnetic field effects, measured by the difference between the parallel and perpendicular pressures, are more pronounced in the beginning of the star evolution when there is a larger number of charged leptons and up quarks. Within the model employed, large magnetic fields appear only at high densities, where the longitudinal matter pressure is large enough to partially compensate for the negative magnetic field longitudinal pressure [2].

[1] M. Strickland, V. Dexheimer and D.P. Menezes, Phys. Rev. D 86, 125032(2012), arXiv:1209.3276[nucl-th].

[2] V. Dexheimer, D.P. Menezes and M. Strickland, arXiv:1210.4526[nucl-th].

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