Relativistic Equations of State at Finite Temperatures

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We study cold and hot nuclear matter in the framework of the nonlinear Walecka model in the Thomas-Fermi approximation. The hyperons of the barionic octet are included. We start by writing the Walecka lagrangian with nonlinear terms, with the inclusion of the eight lightest barions. Application of the Euler-Lagrange equation yields the equations of motion for the fields. Finite temperature effects are then taken into account by adding the Fermi-Dirac distribution function to the expression of the relevant quantities. Energy density and pressure are then calculated as functions of temperature and barionic density. We make mean field approximation in the static case, in order to solve the coupled nonlinear differential equations for self-consistent values of the mean fields. The TM1 set of parameters is used to obtain the thermodynamical quantitites of interest. We also study the particle populations at different temperatures.

The second part of the work consists of a comparative study of the different results of the extended Walecka model in the context of some different sets of parameters, namely: TM1, GL and NL3. We study the behaviour of the effective mass curves of barions for these three sets of parameters at different temperatures and densities. We perform the calculations through a wide range of barionic densities, which allows us concluding that: (i) GL provides a satisfactory description of the nuclear matter for a wide range of densities, though its effective mass curves are stiffer then those with the other two sets; (ii)TM1 fails to describe the effective mass if hyperons are included, as the barionic density comes to ~ 6.5 times the nuclear matter saturation density; (iii) NL3 also fails at ~ 3.5 times the saturation density. In all cases we consider the hyperon-to-meson couplig constant equal to $\sqrt{\frac{2}{3}}$.