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Effect of Landau quantization of the electron on neutron star crust within effective relativistic mean-field model

The crystalline nature of neutron star crust is responsible for various fascinating observational effects such as the crustal moment of inertia, rotational frequency, quasi-periodic oscillations (QPOs) in soft gamma repeaters (SGRs), cooling etc [1, 2]. Most of the observed neutron stars possess a magnetic field of the order of 10^{15} G at the surface and much stronger in the solid crust (also known as magnetars) [3]. In light of this, the structure of the crust in the presence of magnetic field becomes essential to understand the magnetar equation of state (EoS). In this work, we present the outer and inner crust structures to study the role of electron energy quantization using the effective relativistic mean-field model (E-RMF). For outer crust, we minimize the Gibbs free energy using the pioneering variational formalism originally proposed by Baym-Pethick-Sutherland (BPS) [4]. We use the atomic mass evaluation of AME2020 [5], along with the Hartree-Fock-Bogoliubov (HFB) data for nuclear mass. To model the inner crust, which is explicitly model-dependent, we employ the compressible liquid drop model (CLDM) [6], used extensively in recent times for various problems of neutron star crust [7]. We study the effect of quantization of electron motion due to the magnetic field on various crust properties such as the crust composition, transition properties such as density and pressure, pasta structure etc.

Keywords—Neutron star crust, Magnetic field, E-RMF, CLDM

References

[1] D. A. Baiko and A. A. Kozhberov, MNRAS 470, 517 (2017).
[2] N. K. Patra, Tuhin Malik, Debashree Sen, T. K. Jha, and Hiranmaya Mishra, ApJ 900:49, 15 (2020).
[3] Y. D. Mutafchieva, N. Chamel, Zh. K. Stoyanov, J. M. Pearson and L. M. Mihailov, Phys. Rev. C 99, 055805 (2019).
[4] G. Baym, C. Pethick, and P. Sutherland, APJ 170, 299 (1971).
[5] W. Huang, M. Wang, F. Kondev, G. Audi, and S. Naimi, Chinese Physics C 45, 030002 (2021).
[6] Vishal Parmar, H. C. Das, Ankit Kumar, M. K. Sharma, and S. K. Patra, Phys. Rev. D 105, 043017 (2022).
[7] W. G. Newton, M. Gearheart, and B. A. Li, APJ Suppl. Series 204, 9 (2012)

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