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Investigation of a quark matter in hybrid stars

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Quark matter is expected in the core region of neutron stars because of the central density is sufficiently high for nucleons to dissolve into quarks. The compact stars consist of not only nuclear matter but also hyperons and quarks, we call such stars “hybrid stars”. However, the equation of state (EOS) is still not clear and many theoretical studies try to elucidate the EOS in the high density and/or temperature. The crust region of the stars consist of nucleus and nuclear matter. Therefore the inner region of the stars should have hadron-quark mixed phase. Nowadays it is pointed out that the inner structures would affect macroscopic phenomena of the star[1]. However, the inner structures are strongly depend on EOS of the matter. We show that the hadron-quark mixed phase should be restricted to a narrower region because of the finite-size effects and a quark matter region should appear in the central region[2]. The narrow region of the mixed phase seems to explain physical phenomena of neutron stars such as the strong magnetic field and glitch phenomena, and it would give a new cooling curve for the neutron star.

References:

[1] A. Kurkela, P. Romatschke and A. Vuorinen, Phys. Rev. D81, 105021 (2010); arXiv:1006.4062.

[2] T. Endo, Phys. Rev. C 83, 068801 (2011).

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