Possibility of $\Lambda\Lambda$ Pairing in $N\Lambda$ Matter

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The NAGARA event [1] imposes a strong constraint upon the $\Lambda\Lambda$ interaction. This laboratory result consequently gives an impact on the properties of neutron stars. In neutron star matter, it is believed that hyperons appear at densities of a few ρ_0, where ρ_0 being the saturation density; if they become superfluid, it is expected that their cooling would be significantly affected.

Two groups have studied the $\Lambda\Lambda$ pairing in dense nuclear matter up to now and reported sizable pairing gaps based on rather strongly attractive $\Lambda\Lambda$ interactions [2, 3]. But the latest experimental information mentioned above indicates weaker ones. Thus we study the $\Lambda\Lambda$ pairing problem adopting a relativistic interaction, mediated by σ, ω, σ^*, and ϕ, that approximately reproduces the measured bond energy $\Delta B_{\Lambda\Lambda}$ in ${}^{6}_{\Lambda\Lambda}$He. Here, in order to concentrate on the $\Lambda\Lambda$ pairing, we choose symmetric nuclear matter, in which the Λ-Σ^0 mixing does not occur, as the background as in Ref. [2].

The main result is presented in Fig. 1. This figure shows

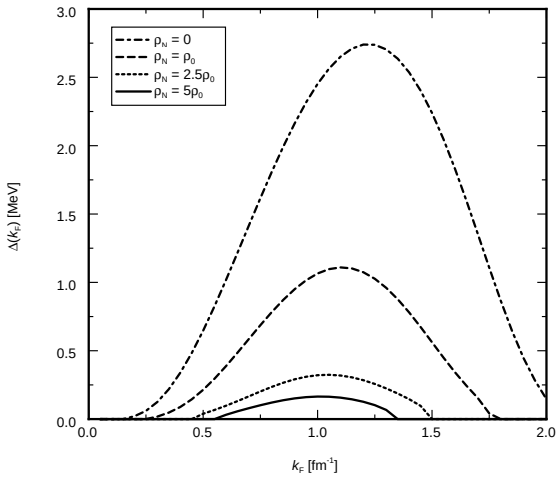

Figure 1: $\Lambda\Lambda$ pairing gap at the Fermi surface of Λ for various background densities.

- $\Delta < 0.5$ MeV at physical densities.
- The density dependence is opposite to that in Ref. [2].

The first conclusion is due to weakness of the attraction. The second one is brought about by the density dependence of the Dirac effective mass of Λ immersed in the dense background.

References

[1] H. Takahashi et al., Phys. Rev. Lett. **87** (2001) 212502.
[2] S. Balberg and N. Barnea, Phys. Rev. C **57** (1998) 409.
[3] T. Takatsuka and R. Tamagaki, Prog. Theor. Phys. **102** (1999) 1043.