Possibility of $ΛΛ$ Pairing in $NΛ$ Matter

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The NAGARA event [1] imposes a strong constraint upon the $ΛΛ$ 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 $ΛΛ$ pairing in dense nuclear matter up to now and reported sizable pairing gaps based on rather strongly attractive $ΛΛ$ interactions [2, 3]. But the latest experimental information mentioned above indicates weaker ones. Thus we study the $ΛΛ$ pairing problem adopting a relativistic interaction, mediated by $σ$, $ω$, $σ^*$, and $φ$, that approximately reproduces the measured bond energy $ΔB_{ΛΛ}$ in $^{6}_{ΛΛ}$He. Here, in order to concentrate on the $ΛΛ$ 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

- $Δ < 0.5$ 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