Concerning one possibility of cooling solid He^3

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It is proposed to use the strong dependence of the magnetic-ordering temperature on the degree of compression for additional cooling of solid He^3.

According to present-day concepts, the tendency towards magnetic ordering of solid He^3 is a result of an exchange interaction that is caused by the large amplitude of the zero-point oscillations of the crystal atoms. The square of the ratio of the amplitude to the atomic distance a is qualitatively determined by the parameter $\Lambda = h/a\sqrt{m\epsilon}$ [1] (m is the mass of the atom and ϵ is the characteristic interaction energy). If the energy ϵ increases upon compression more rapidly than a^{-2}, and this is indeed the case, then the parameter Λ decreases. Since the exchange energy depends exponentially on the overlap of the wave functions of the neighboring atoms, and the latter are in fact determined by the value of Λ, the temperature Θ of the magnetic ordering should decrease abruptly upon compression of solid He^3. These qualitative arguments are confirmed by the results of numerical calculations[2] and by experimental data on the magnetic susceptibility. Thus, for example, according to the measurements of Kirk *et al.*[3] the Curie point Θ_p of bcc He^3 decreases by one order of magnitude when the specific volume changes from 24 cm^3/mole to 21 cm^3/mole.

The purpose of this communication is to call attention to the fact that this phenomenon can be used for further cooling of solid He^3 by adiabatic compression, after the

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magnetic-ordering temperature is reached. In fact, when cooling below the point Θ, the spin part of the entropy decreases abruptly, and since it determines practically completely the entropy of the crystal in the considered region of temperatures, the inequality $T < \Theta$ is preserved in adiabatic compression, and in view of the strong decrease of Θ the temperature of the crystal is appreciably lowered as a result of this process.

Recently Halperin *et al.*[4] observed, for the first time, the transition of solid He^3 into a magnetically order phase with $\Theta = 1.17$ mK. The use of the aforementioned cooling possibility will make it possible to extend the measurements to submillidegree temperatures.

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