# Report on LG18284

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## Inconsistency of the conventional theory of superconductivity

This paper is one of a series of papers by the author on a proposed thermodynamic inconsistency of the conventional theory of superconductivity. The papers call into question the long accepted notion that the equilibrium state of a type I superconductor depends only on the state variables temperature and magnetic field and NOT on the history leading to that state. To demonstrate that something might be wrong or at least incomplete with the conventional picture of superconductivity, the author evaluates thermodynamic quantities of the end point of a simple process: the cooling process taking the system from temperature $T_1$ to temperature $T_2$ in external magnetic field $H_0$.

Calculating the entropy change, assuming a finite cooling rate, the author finds that extra entropy is generated by dissipative processes involving the “normal fluid” (the thermally excited Bogoliubov quasiparticles). This extra entropy depends on the way the cooling process is run. On the basis of this result the author concludes that there is a conflict with the statement that the final state of the cooling process should be a thermal equilibrium state. In the limit of infinitely slow cooling rate everything is fine, though.

In my opinion the solution to this seeming conundrum is as follows. In the case of finite cooling rate the entropy is expected to increase beyond the thermodynamic entropy change. The final state is necessarily a nonequilibrium state. This implies, e.g. that the Bogoliubov quasiparticle distribution is not a Fermi distribution. However, the coupling to the thermal reservoir causes the system to equilibrate. As a consequence the extra entropy is removed. This happens within a microscopic relaxation time. After that the system is in a bona fide equilibrium state. This is what is apparently observed in experiment. There is no conflict with the conventional theory of superconductivity.

So, in my view, the thermodynamic process considered by the author is incomplete. If a finite cooling rate is employed, at the end of the process the relaxation to the equilibrium state necessarily has to be included.

To summarize, the conclusion that the result of the calculation presented in the paper proves the thermodynamic inconsistency of the conventional theory of superconductivity is not correct. The paper should not be published.