From: **Int. J. Mod. Phys. B (IJMPB)** em@editorialmanager.com
Subject: [IJMPB] JPB20076297 Decision
Date: March 10, 2020 at 21:28
To: J. E. Hirsch jhirsch@ucsd.edu

Journal Title: International Journal of Modern Physics B
Submission No.: JPB20076297
Submission Title: Thermodynamic inconsistency of the conventional theory of superconductivity

Dear Dr. Hirsch,

The review comments on the paper above have been received. Revisions have been suggested for this paper. The review comments can be found at the end of this email.

If you decide to revise the paper, please submit a list of changes and highlight in the revised paper. If you disagree with the review comments and recommendations, please provide a rebuttal against each point when you submit the revised paper.

To submit a revision, go to https://www.editorialmanager.com/ijmpb/ and log in as an Author. You will see a menu item call Submission Needing Revision. You will find your submission record there.

The revision is due by May 10, 2020.

Yours sincerely,

IJMPB Editor
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International Journal of Modern Physics B
http://www.worldscinet.com/ijmpb/

Review comments:

Reviewer #1: Review of the paper J. E. Hirsch "Thermodynamic inconsistency of the conventional theory of superconductivity"

I counted a dozen of the author's claims about inconsistency of the conventional theory of superconductivity, and that the theory is incompatible with the laws of physics before the author explained the essence of the matter in Section VIII.
As it turned out, everything is not so bad: if the cooling process of the superconductor is very slow, then these claims of the author have no basis in fact (page 10 of the paper). If this process is carried out in a finite time, then, of course, the observables will differ from the predictions of the conventional theory. But, very important, this process is nonequilibrium one, and temperature cannot be the same
in different areas of the superconductor.
It should be noted that the generally accepted microscopic theory based on the BCS theory and Bogolyubov's approach, as well as the early phenomenological theory of the London brothers, is developed for the equilibrium and quasistatic thermodynamic processes. Therefore, the author's statement about any "thermodynamic inconsistency" of the theory is simply incorrect. One should not require a description of nonequilibrium processes from the conventional theory developed for equilibrium states.
The author claims that "the physical mechanism by which these changes in momenta happen in the process of normal electrons condensing into the superconducting state… has never been discussed in the superconductivity literature". This is completely wrong since the author does not use the microscopic theory at all. This is explained by the condensate wave function. The latter defines the phase of the single boson wave function. This phase, which determines the momentum distribution for bosons, is the same for all condensed particles.
I suppose that the content of this article most likely corresponds to the following: "Generalization of the London's phenomenological theory to non-stationary cooling processes of the type I superconductor in a constant magnetic field". But two objections are raised in this way.
First, the author considers the cooling of the superconductor due to heat transfer through the surface of the contacting bodies. At certain cooling rates and the superconductor sizes, a time-dependent temperature field must appear into the superconductor. The London approach cannot be used to describe such nonequilibrium state. It should be investigated using microscopic theory (see, for example, Kopnin N.B. Theory of Nonequilibrium Superconductivity). Cooling rates necessary to avoid this do not calculated and not discussed by the author.
Second, Eq. (26) at the beginning of Section V and, since it is crucial for calculation of the vortex electric field, all of the following formulas are very doubtful to me. Really, the author just take the formula for the magnetic field distribution in the cylinder for the equilibrium state and use it for the time-varying state, assuming $\lambda_{L}(t)$. Since the cooling process is not specified by the necessary estimates, the vortex electric field must, at least, be found the complete system of Maxwell-Lorentz equations.
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