

Response to report on WJ10056/Hirsch

I would like to thank the reviewer for his/her time and effort in reviewing my paper.

Unfortunately the referee did not understand the puzzle I am proposing to resolve. I have explained it extensively in other papers but not in this one, and it appears the referee is not familiar with those other papers.

Let me start by addressing the comments of the referee (reproduced in italics):

*"Eq. 2 does not consider the diamagnetic response of perfect conductors"*

The diamagnetic response of a perfect conductor is: when a magnetic field is applied, the perfect conductor generates a current that produces a magnetic field opposite to the applied one, so the field does not penetrate beyond the penetration depth.

That is Faraday's law, and of course I am considering it, e.g. Eq. (3).

But Faraday's law doesn't explain why a magnetic field is expelled when a metal goes superconducting. On the contrary, it predicts that in a perfect conductor magnetic field lines are frozen, so they can't be expelled.

The referee further says: *"This response (which for superconductors is known as London equation) is not phenomenological as the author hints. Rather, it is rigorously derived for superconductors."*

That is not so. The London equation describes the state where the magnetic field is expelled. It does not explain the process of how it is expelled, from the initial state where the magnetic field is in the normal metal. Neither does BCS theory. The "proof" of the London equation and the Meissner effect in BCS theory is based on linear response, starting with the system in the BCS state and then applying a magnetic field. That is not the Meissner effect, the Meissner effect is the process by which a normal metal expels magnetic field in the process of becoming superconducting. The initial state is the normal metal with a magnetic field inside, it is not the BCS state that cannot have a magnetic field inside.

The referee says *"he must explain better why the basic equation on which his theory relies does not give rise to diamagnetism."*

I have explained it at length in other papers, in particular refs. 11, 14, 15, 16, 18 of this paper.

I could add a section at the beginning of this paper explaining why BCS theory nor London equations explain the Meissner effect, if that is what would be required to publish this paper. It would repeat the arguments already contained in those references.