

Abstract Submitted
for the MAR05 Meeting of
The American Physical Society

Problem of Gauge Invariance in the BCS theory: Revisited

YONG-JIHN KIM, University of Puerto Rico-Mayaguez — It is well known that the derivation of the Meissner effect in the BCS theory is not gauge invariant. We reconsider this fundamental problem from a few different aspects. First, we point out that the gauge invariance is basically one particle property, although we are dealing with the many body BCS wavefunction. Second, if the field operators are transformed due to the gauge change, it is trivial to show the gauge invariance. Third, if the BCS state is changed instead according to the gauge transformation, we need to pair the states which include the effects of the perturbation. In fact, this point was realized by Bogoliubov, Blatt, and Ambegaokar and Kadanoff. However, their investigations were only formal and didn't pursue the implications of this generalized pairing on the electrodynamics of the BCS superconductors. We show that the generalized pairing leads to a gauge invariant derivation of the Meissner effect. We also discuss the resulting refinement of the electrodynamics of the BCS superconductors.

Yong-Jihn Kim
University of Puerto Rico-Mayaguez

Date submitted: 01 Dec 2004

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