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Landau Diamagnetism and Meissner effect in the BCS Theory YONG-JIHN KIM, University of Puerto Rico — When the energy gap becomes zero, the BCS wavefunction leads to the free electron gas wavefunction. The free electron gas shows the Landau diamagnetism, whereas the superconducting electrons show the perfect diamagnetism, i.e., Meissner effect. However, the magnetic response of the BCS theory does not lead to the Landau diamagnetism for zero gap. It was argued that the small Landau diamagnetism would appear only in a higher order, although the Landau diamagnetism of free electrons is obtained in a linear order in the magnetic field. Here we show that a gauge-invariant derivation of the Meissner effect from the BCS wavefunction leads to the Landau diamagnetism for the zero gap case. We discuss the implications of this study on the electrodynamics of BCS superconductors and the Anderson-Higgs mechanism.

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