Temperature Dependence of the Solution of the BCS gap equation

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The existence and uniqueness of the solution to the BCS gap equation for superconductivity were established, but the temperature dependence of the solution was not covered in previous works. In this talk, in order to show how the solution varies with the temperature, I first give another proof of the existence and uniqueness of the solution and point out that the solution belongs to a certain set. Here this set depends on the temperature T. I define another certain subset of a Banach space consisting of continuous functions of both T and x. Here, x stands for the kinetic energy of an electron minus the chemical potential. Let the solution be approximated by an element of the subset of the Banach space above. I second show, under this approximation, that the transition to a superconducting state is a second-order phase transition. I finally show that the solution is continuous with respect to both T and x when T is small enough.