Due on 2018-03-28, 23:59 IST
Advanced Condensed Matter Physics/S. Basu/Assignment-7

Only correctness of the final answers will be checked. You may box the final answer.

1. Express the average number of particles in terms of $|v_k|^2$ where $|v_k|^2$ is the probability of the occupied states.

2. Use the following Bogoliubov-Valatin transformation:

$$c_k = u_k^* \gamma_{k0} + v_k \gamma_{k1}$$
$$c_{-k} = -v_k^* \gamma_{k0} + u_k \gamma_{k1}$$

where $\gamma$’s are quasiparticle operators.

(a) Evaluate $\{\gamma_k, \gamma_k^\dagger\}$.

(b) Assume the gap equation to have the form:

$$\Delta_k = -\sum_{k'} V_{kk'} \langle c_{-k'} c_k^\dagger \rangle$$

write $\Delta_k$ in terms of $\gamma_k$ and $\gamma_k^\dagger$.

(c) Finally, if

$$\langle 1 - \gamma_{k0}^\dagger \gamma_{k0} - \gamma_{k1}^\dagger \gamma_{k1} \rangle = \tanh(\beta E_k/2)$$

, obtain the familiar form of BCS equation.

3. What is the value of $\frac{2\Delta}{k_BT_c}$ for a BCS superconductor? What is the value for high temperature superconductors?

4. (a) Write down the free energy functional, $F_S$ in terms of the order parameter (upto fourth order) for a superconductor measured with respect to the normal state value, $F_N$.

(b) Minimize $F_S$ to obtain the $F_s - F_N$.

(c) What is the order parameter for $T > T_c$ and $T < T_c$, $T_c$ being the transition temperature.

5. Consider a metal-superconductor interface at $x = 0$, write down the variation of the order parameter, $\psi$ as a function of the distance from the boundary.

Your Submission:

Due Date Exceeded.
As per our records you have not submitted this assignment.