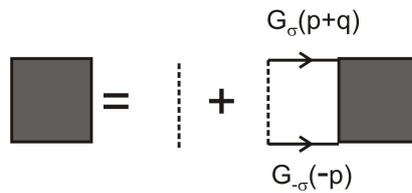


**Homework assignment 4: Superconductivity (Chapter 14 from Coleman' textbook/  
Lecture notes)**  
(Dated: January 9, 2020)



- **Problem 1:** Cooper instability. Assume attractive interaction with constant amplitude for electrons with energies within the Debye frequency-determined shell near the Fermi surface. Calculate the scattering amplitude in the Cooper channel (see diagram in the figure) and find the pole of the vertex function emergent in result of the attractive interaction.
- **Problem 2:** Gor'kov equations and Bogolubov-de Gennes equations.  
Consider Gor'kov equation for the Green's function (paragraph 14.7 from the textbook/Lecture notes). Show that the solution of Gor'kov equation can be represented using spectral decomposition through the eigen functions of Bogolubov-de Gennes equation. Find the spectrum of quasiparticles in homogeneous superconductor solving the Bogolubov-de Gennes equations.
- **Problem 3:** Andreev scattering. Using Bogolubov-de Gennes equations consider the reflection of electron from normal metal/superconductor interface. For simplicity assume that the energy of incident electron lies exactly at the Fermi level.