Evento	Salão UFRGS 2022: SIC - XXXIV SALÃO DE INICIAÇÃO CIENTÍFICA DA UFRGS
Ano	2022
Local	Campus Centro - UFRGS
Título	Interação elétron-fônon e elétron-elétron efetiva: método da transformação de Schrieffer-Wolff
Autor	MURILO KESSLER DE AZAMBUJA
Orientador	MILTON ANDRE TUMELERO

The phenomenon of superconductivity was first observed by the Dutch physicist Heike Kamerlingh Onnes in 1911 while investigating the behavior of the resistivity in metals at low temperatures, and since then it has become a topic of great interest in the physics of condensed matter. It was only 46 years later, in 1957, that Bardeen Copper and Schrieffer (BCS) published a microscopic theory of the superconductivity that explained satisfactorily many experimental phenomena, like the isotope effect in the critical temperature and the energy gap at the Fermi energy. The BCS theory of superconductivity is today a paradigmatic model in the physics of many body quantum mechanics and is based in a attractive interaction between pairs of electrons in the solid, mediated by some kind of boson. In the original model, it's the interaction between electrons and virtual phonons, quantized lattice vibrations in a solid that have boson-like behaviour, that cause the atractive interaction. However, the model Hamiltonian proposed in the BCS theory only postulates that such interaction exists, given some conditions are satisfied, which gives us very little information on the dynamics of the electron-phonon system.

In this project we made a quick revision of the electron-phonon Hamiltonian in a solid and used a Schrieffer-Wolff unitary transformation as an approximation method, turning the complete Hamiltonian into an "effective Hamiltonian", perturbative in the electron-phonon interaction. We verified that the transformation turns the complete electron-phonon interaction into an effective electron-electron interaction mediated by phonons, which is attractive given the electrons pairs are in certain range around the Fermi energy. We also showed that if some simplifying considerations are made, the original BCS model Hamiltonian is obtained from the effective interaction.