Abstract

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We are interested in investigating the dynamics of a coupled electron-phonon system within the Schwinger Keldysh formalism, where both the electrons and phonons are allowed to evolve in time self-consistently, as opposed to the standard paradigm of one set of constituents forming a static bath for the other.

As the initial condition of our problem, we envision the electrons being at temperature T_{el} and the phonons being at some other temperature $T_{ph} \neq T_{el}$. At t = 0 the interaction is switched on and the system is allowed to evolve while exchanging energy and momenta between the electrons and phonons. However, the total number of electrons doesn't change, which restricts the form of the interaction to involve only terms with equal number of fermionic creation and annihilation operators (or $U(1)$ symmetric action). We consider this model in keldysh field theory, with description

$$S_K = \int_{\mathcal{C}} \frac{1}{2} \phi^T D^{-1} \phi + \int_{\mathcal{C}} \frac{1}{2} \bar{\Psi} G^{-1} \Psi + \int_{\mathcal{C}} \lambda \bar{\Psi} \Psi \phi$$

Integrating out the bosons would lead to a phonon mediated effective four-fermion interaction of $O(^2)$, whereas, integrating out the electrons would lead to a self-energy ^{ph} for the phonons. We're studying this model to understand equilibriation dynamics in more detail.