Solving the Two-time Kadanoff-Baym Equations.
Status and Open Problems

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Time dependent energy-current of open and interacting systems out of equilibrium.

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Within the non-equilibrium Green’s function formalism we derive a formal expression for the time-dependent energy-current flowing through a nanoscale interacting systems coupled to two metallic leads.
We find, as in the Meir-Wingreen formulation for the particle-current, that also the energy-current may be written in terms of the non-equilibrium single-particle Green's fuction and the embedding self-energy. Unlike in the case of the particle current also the many-body self-energy appears in the expression for the energy-current. Our derivation ensures that the energy-current is computed consistently with the approximations used for the single-particle Green’s function.
From a numerical point of view, the specific form of this expression, can be easily implemented in both the two-time approach or in the GKBA limit. We obtain two main contribution for the current: the first one proportional to the non-interacting energy times the population of the system and describing how the energy is carried out by particles that flow into/from the system from/to the leads; the second one, instead, directly related to the many-body self-energy and illustrating how the energy-current changes due to the presence of the interaction.