ID de Contribution: **7** Type: **Non spécifié**

Many-body quantum heat engines based on free-fermion systems.

lundi 5 février 2024 16:30 (45 minutes)

We study the thermodynamics of free-fermion systems coupled to quantum thermal baths within a Markovian approximation. In particular, we construct a four-stroke quantum Otto engine by alternately coupling such kind of systems to two reservoirs at different temperatures and operating adiabatic switches of some Hamiltonian parameters, followed by isochoric transformations.

We show that the engine can operate in four different modes; in particular it can act as a heat engine and as a refrigerator, with thermodynamic performances that are affected by the possible presence of quantum criticality in the model. We also discuss the effects of non perfect thermalization with the baths and of adiabatic processes which are executed in a finite width of time.

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