# LIMITATIONS ON COHERENT WORK EXTRACTION IN OPEN QUANTUM SYSTEMS

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As the miniaturization of thermal machines advances towards ever-smaller scales [2], the question arises how quantum effects such as coherence will influence their performance, see for example [3]. Here, we investigate this problem for heat engines operating periodically and under weak-coupling conditions.
To assess the role of quantum effects, the total energy content of the working substance is divided into a passive part and one which can be extracted through coherent operations [4]. Using this scheme, we obtain a refined version of the first law, which allows us to derive a general criterion necessary for coherent work extraction. Specializing to Lindblad dynamics, we identify different universality classes of systems in which quantum effects can only decrease the total power.
In the limit of small driving amplitudes, we recover previously obtained bounds for the linear-response regime [5]. Our new bounds are, however, valid also arbitrarily far from equilibrium, that is, for strong and fast driving. Thus, our results are a step towards a systematic understanding of the role of coherence for power generation in open quantum systems.

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