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Thermodynamics of a minimal interacting heat engine: Comparison between engine designs

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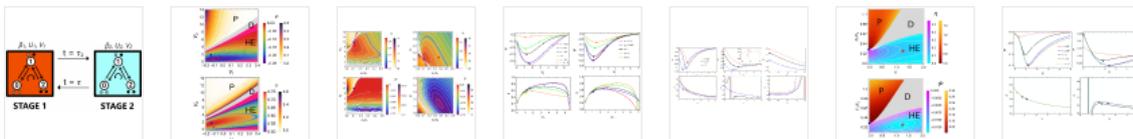
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ABSTRACT

Collective effects stemming from many interacting units have attracted remarkable recent interest, not only for their presence in several systems in nature but also for the possibility of being used for the construction of efficient engine setups. Notwithstanding, little is known about the influence of the engine design, and most studies are restricted to the simplest cases (e.g., simultaneous contact with two thermal baths), not necessarily constituting a realistic setup implementation. In order to investigate the design and its influence on the performance, we introduce the collisional also referred as sequential description for a minimal model for interacting heat engines, composed of two coupled nanomachines placed in contact with a distinct thermal reservoir and subjected to a nonequilibrium work source at each stage. Thermodynamic quantities are exactly obtained irrespective of the model details. Distinct kinds of work sources are investigated and the influence of the interaction, temperature, period, and time asymmetry has been undertaken. Results show that a careful design of interaction provides superior performance than the interactionless case, including optimal power outputs and efficiencies at maximum power greater than known bounds or even the system presenting efficiencies close to the ideal (Carnot) limit. As a complementary analysis, we also show that the case of the system simultaneously placed in contact with two thermal reservoirs constitutes a particular case of our framework.


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