Title:	Quantum Heat Engines with Complex Working Media, Complete Otto Cycles and Heuristics.
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Abstract:	Quantum thermal machines make use of non-classical thermodynamic resources, one of which include interactions between elements of the quantum working medium. In this paper, we examine the performance of a quasi-static quantum Otto engine based on two spins of arbitrary magnitudes subject to an external magnetic field and coupled via an isotropic Heisenberg exchange interaction. It has been shown earlier that the said interaction provides an enhancement of cycle efficiency, with an upper bound that is tighter than the Carnot efficiency. However, the necessary conditions governing engine performance and the relevant upper bound for efficiency are unknown for the general case of arbitrary spin magnitudes. By analyzing extreme case scenarios, we formulate heuristics to infer the necessary conditions for an engine with uncoupled as well as coupled spin model. These conditions lead us to a connection between performance of quantum heat engines and the notion of majorization. Furthermore, the study of complete Otto cycles inherent in the average cycle also yields interesting insights into the average performance.
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