Efficiency bounds for quantum engines powered by non-thermal baths

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Abstract

We analyse the operation principles and performance bounds of quantum engines whose working fluid (WF) is energised by a non-thermal bath. We show that such a bath (e.g., a squeezed or coherently displaced thermal bath) can render the WF state non-passive, i.e., capable of storing and delivering work. This non-passivity converts the heat engine into a thermo-mechanical machine that is powered by mechanical work, as well as heat, from the non-thermal bath. Its efficiency is unrestricted by the Carnot bound, which only applies to heat engines. By contrast, for certain WF–bath interactions and non-thermal bath states the WF thermalises. The machine then operates as a heat engine, but its Carnot bound may correspond to a higher temperature than its thermal-bath counterpart.

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