Title:	Unified trade-off optimization of a three-level quantum refrigerator.
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Abstract:	We study the optimal performance of a three-level quantum refrigerator using a tradeoff objective function, Ω function, which represents a compromise between the energy benefits and the energy losses of a thermal device. First, we optimize the performance of our refrigerator by employing a two-parameter optimization scheme and show that the first two terms in the series expansion of the obtained coefficient of performance (COP) match with those of some classical models of the refrigerator. Then, in the hightemperature limit, optimizing with respect to one parameter while constraining the other one, we obtain the lower and upper bounds on the COP for both strong as well as weak (intermediate) matter-field coupling conditions. In the strong matter-field coupling regime, the obtained bounds on the COP exactly match with the bounds already known for some models of classical refrigerators. Further, for weak matter-field coupling, we derive some new bounds on the COP of the refrigerator, which lie beyond the range covered by bounds obtained for strong matter-field coupling. Then, in the parameter regime where both cooling power and Ω function can be maximized, we compare the cooling power of the quantum refrigerator at maximum Ω function with the maximum cooling power. Finally, in addition to carrying optimization over the internal parameters (frequencies) of the three-level system, we optimize the performance of the three-level model with respect to system-bath coupling parameters and highlight its implications on the performance of both engine and refrigerator modes of operation
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