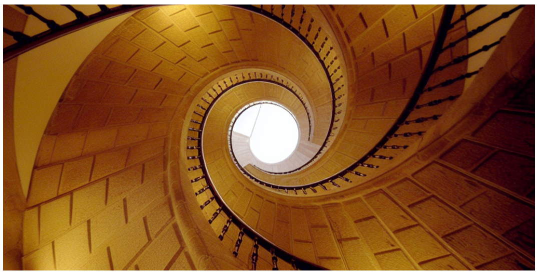

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Coherence for quantum-enhanced thermodynamic performance in steady-state quantum thermal machines

Quantum coherence has been shown to impact the operational capabilities of quantum systems performing thermodynamic tasks in a significant way, and yet the possibility of genuine coherence-enhanced thermodynamic operation remains unclear. Here we show that only the presence of energetic coherence —coherence between levels with different energies— in steady-state quantum thermal machines can lead to genuine thermodynamic advantage. On the other hand, engines showing coherence between degenerate levels, or subjected to noise-induced coherence, are shown to be systematically emulated by classical stochastic engines using exactly the same set of (incoherent) resources. We illustrate our results with three famous models of heat engines and refrigerators and employ multi-objective optimization techniques to characterize quantum-enhanced regimes in connection with the thermodynamic uncertainty relation.

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