Quantum thermodynamics under control

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Over the past few years we have endeavored to merge the fields of quantum control and thermodynamics, by examining the effects of control fields on quantum thermodynamic machines. This endeavor has resulted in the formulation of general principles that nonequilibrium thermodynamics must abide by in the quantum domain [1-3]. These principles dispel much of the confusion in the literature concerning the questions: What are work and heat in the quantum domain? Can a quantum machine surpass the Carnot bound on efficiency, as previously claimed? What (if any) quantum advantage can we expect from machines that operate in the quantum domain? I will illustrate our answers to these questions for our designs of heat engines, refrigerators, diodes and transducers/ transistors based on quantum systems [4-7].

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