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Abstract:	In recent years, a revolutionary understanding of thermodynamics has emerged that ex- plains it's use in quantum regime and captures highly non trivial restrictions that de- termines thermodynamically feasible transformations. The understanding is based on the perspective of resource theory and admits a close interplay between energetic and entropic quantities on the ground of quantum information theory. Such theories com- pletely characterize possible thermodynamically allowed state transformations (TAST) between states diagonal in eigenbasis of system hamiltonian but are incapable to char- acterize transformation between general states with coherence terms. In this thesis we explore necessary and sufficient conditions of TAST for states with coherence in energy eigenbasis. We further apply this to construct general transformation laws for quantum heat engine working in a resource theoretic framework. We also explicitly work out var- ious types of pure to pure state TAST and bring out how restrictive they are in regards to which states are thermodynamically accessible. Overall this thesis takes on a journey to explore new grounds of thermodynamics at nanoscale regime leaning on concepts from information theory, physics, computer science and mathematics.
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