The quantum Carnot engine and the inertial theorem

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Quantum thermodynamics follows the tradition of learning by example. The Carnot cycle would be a primary candidate. Previous attempts to model the four stroke quantum Carnot cycle failed due to the difficulty to model the isothermal branches, where the working medium is driven while in contact to the thermal bath. Motivated by this issue we derived a time dependent Non Adiabatic Master Equation (NAME) with an explicit constant adiabatic speed time dependent driving protocol. This master equation is consistent with thermodynamic principles. We then were able to generalise to protocols with small acceleration with respect to the constant speed protocols. This approach was confirmed experimentally for a qubit composed of a driven Ytterbium ion in a Paul trap. Utilising the NAME and the inertial theorem we are able to construct shortcuts to an isothermal transformation. Unlike unitary transformations the shortcut map changes entropy. These fast protocols have a price in dissipated work. After this journey, we are able to obtain a Carnot type cycle with finite power. We explore the tradeoff between power and efficiency in a shortcut engine and in an endo-reversible model. The role of coherence in the cycle is emphasised. We are able to identify the quantum signature of a Carnot type cycle with global coherence.