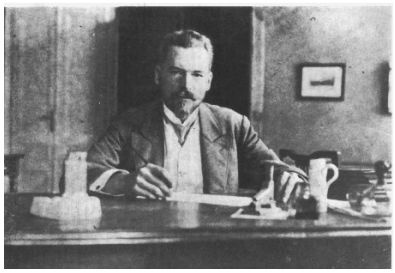

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The role of ergotropy in the quantum thermodynamics

Friday, 4 December 2020 13:40 (20)

Ergotropy is a state function of a density matrix which physical interpretation is the optimal work that can be extracted through the arbitrary unitary channel. The concept naturally appears in frameworks with implicit work reservoirs (e.g. external fields modeled by time-dependent Hamiltonians), where, in particular, the process of charging and discharging of so-called quantum batteries is studied. We reveal that the same quantity appears in autonomous systems with an idealized model of the work reservoir - a quantum weight. Despite similarities between those two approaches, we reveal a fundamental difference, namely the emergence of the locked energy in coherences, i.e. the quantum part of the state that contributes to ergotropy but cannot be extracted as a work. Furthermore, we prove the relation between the ergotropy and free energy, where the former can be interpreted as a generalization of the latter for systems coupled to finite-size heat baths, such that in the thermodynamic limit the total ergotropy of the system and the heat bath approaches the free energy. As a consequence, we derive the second kind of locked energy, due to the finite-size of the bath, which is given by the difference of free energy between the global passive state and the corresponding equilibrium state.

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