Thermodynamics of Quantum Information Flows

K. Ptaszyński[a] and M Esposito[b]

[a]Institute of Molecular Physics, Polish Academy of Sciences, M. Smoluchowskiego 17, 60-179 Poznań, Poland
[b]Complex Systems and Statistical Mechanics, Physics and Materials Science Research Unit, University of Luxembourg, L-1511 Luxembourg, Luxembourg

We report[1] two results complementing the second law of thermodynamics for Markovian open quantum systems coupled to multiple reservoirs with different temperatures and chemical potentials. First, we derive a nonequilibrium free energy inequality providing an upper bound for a maximum power output, which for systems with inhomogeneous temperature is not equivalent to the Clausius inequality. Secondly, we derive local Clausius and free energy inequalities for the subsystems of a composite system. These inequalities, which generalize an influential result obtained previously for classical bipartite systems,[2] differ from the total system one by the presence of an information-related contribution and build the ground for thermodynamics of quantum information processing. Our theory is used to study an autonomous quantum Maxwell demon based based on quantum dots.

[1]K. Ptaszyński and M. Esposito *Thermodynamics of Quantum Information Flows*, arXiv:1901.01093 (2019).
[2]J. M. Horowitz and M. Esposito *Thermodynamics with Continuous Information Flow*, Phys. Rev. X **4**, 031015 (2014).