Title:	Near-equilibrium universality and bounds on efficiency in quasi-static regime with finite source and sink
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Abstract:	We show the validity of some results of finite-time thermodynamics, also within the quasi-static framework of classical thermodynamics. First, we consider the efficiency at maximum work (η0) from finite source and sink modelled as identical thermodynamic systems. The nearequilibrium regime is characterized by expanding the internal energy up to second order (i.e. up to linear response) in the difference of initial entropies of the source and the sink. It is shown that the efficiency is given by a universal expression 2ηC/(4 - ηC), where η C is the Carnot efficiency. Then, different sizes of source and sink are treated, by combining different numbers of copies of the same thermodynamic system. The efficiency of this process is found to be η0 = ηC/(2-γηC), where the parameter γ depends only on the relative size of the source and the sink. This implies that within the linear response theory, η0 is bounded as ηC/2 ≤ η0 ≤ ηC/(2 - ηC), where the upper (lower) bound is obtained with a sink much larger (smaller) in size than the source. We also remark on the behavior of the efficiency beyond linear response.
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