

Excess Entropy Production Viewed at Different Scales

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Modeling physical systems, we sometimes face a problem that there is arbitrariness in the choice of the scale and variables for the description. Depending on the scales of description, some physical quantities like heat, internal energy and entropy of the system, may have the different values. Sekimoto discussed such dependence of the physical quantities and found that the total entropy production is kept invariant with respect to the change of the description, when the dynamics has an equilibrium state[1]. However, it has recently been shown for the several nonequilibrium setup that the total entropy production may also depend on the levels of description [2, 3, 4].

We approach this problem from the viewpoint of nonequilibrium steady state thermodynamics, and show for general Markov processes and several definitions of excess entropy productions [5, 6, 7] that the sum of the system's entropy increment and the excess entropy production has a description-independent value under a certain condition [8]. This means that the second-law like relations of nonequilibrium thermodynamics are kept invariant, even when the value of the total entropy production varies according to the change of description.

References

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