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Irreversible thermodynamics and Glansdorff–Prigogine principle derived from stochastic thermodynamics

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Abstract

We derive the main equations of irreversible thermodynamics including the expression for the Glansdorff–Prigogine extremal principle from stochastic thermodynamics. To this end, we analyze a system that is subject to gradients of temperature and external forces that induce the appearance of fluxes of several sorts and the creation of entropy. We show that the rate of entropy production has a bilinear form and is a convex function of the fluxes, from which it follows that the excess entropy production is nonnegative, which is an expression of the Glansdorff–Prigogine principle. We show that the Lyapunov function associated with the excess entropy production can be identified with a thermodynamic potential in the special case where the gradients of temperature are absent.

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