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Nonlinear fluctuation-dissipation relations and stochastic models in nonequilibrium thermodynamics: I. Generalized fluctuation-dissipation theorem

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Abstract

The paper is devoted to the theory of thermal fluctuations in nonlinear macroscopic systems and to the derivation of variational principles of nonlinear nonequilibrium thermodynamics. In the first part of the paper rigorous universal fluctuation-dissipation relations for nonlinear classical and quantum systems, subjected to dynamic as well as thermodynamic perturbations, are derived and analyzed. General expressions for dissipative fluxes and nonlinear transfer coefficients with the help of fluctuation cumulants are found. The canonical structure of nonlinear evolution equations of macrovariables is derived and the rule of introducing Langevinian random forces into

these equations, in accordance with fluctuation-dissipation relations. A Markovian theory of fluctuations in a stationary nonequilibrium state is constructed.



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