

A PATH FROM EQUILIBRIUM TO NONEQUILIBRIUM THERMODYNAMICS

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ABSTRACT

In the last decades new ideas have arisen in thermodynamics as a consequence of the advances in the applications of dynamical systems theory and results to evolution of macroscopic systems. A key question is whether it is possible to extend the domain of thermodynamics from a general theory of relations between equilibrium states to the much more general analysis of relations and properties of stationary states arising under steady forcing of mechanical systems in contact with heat reservoirs. The familiar description of equilibrium via probability distributions (like the microcanonical ensemble) which predicts relations between observables extending the ones of classical thermodynamics has been widely extended and under general assumptions an extension of the theory of ensembles has been proposed. The new theory contains classic thermodynamics, as derived from statistical mechanics, as a special case: it relies on ‘chaos’ and raises important questions that are still debated: is there a suitable extension of the ‘entropy’, are there universal relations that can be theoretically predicted?

Keywords: equilibrium, nonequilibrium, system theory, evolution, thermodynamics