## ○ お茶の水女子大学理学部物理学教室



# 1. 熱的輸送現象の複素熱容量理論

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The response of a linear dissipative system to an external perturbation is described directly by the linear response theory if the perturbation is mechanical. The response to an external thermal perturbation or an irreversible process induced by the inhomogeneity produced within a system (for example, the conduction of heat, the diffusion, and the viscous flow) can not be described in the same way as the response to mechanical perturbations, since in the Hamiltonian there is no term which describes a thermal gradient (for example, the temperature gradient, the concentration gradient, and the velocity gradient).

However, the effect of a thermal perturbation can be produced by a suitably chosen mechanical external field of force, because a thermal gradient or the inhomogeneity of a quantity, such as the temperature, is nothing but the inhomogeneity of another quantity like the energy density, and the latter can be equally produced by an external mechanical force. Namely, whichever of two different origins, thermal perturbation or external field, induced a transport phenomenon, there should be no difference in the kinetic and the relaxation properties. On this basic idea, various authors (Montroll[1], Kadanoff-Martin[2], Luttinger[3], Salistra[4]) attempted to construct the linear response theory of thermal transport phenomena. In this paper, Salistra's method is examined. Salistra introduced a new concept, the "complex heat capacity", which describes the response of energy distribution within a system to the temperal and spatial variation in the temperature. First, Salistra's derivation of the statistical mechanical expression of complex heat capacity is improved into quantum mechanically more complete one, as his derivation was partially classical. Furthermore, Salistra's expression of the complex heat capacity, which is based on the Fourier's law, is generalized to the case of the Vernotte's law or a more generalized non-local, non-Markovian law of heat conduction. Second, the complex heat capacity under the condition of coexistence of viscous flow is also discussed.