

Thermodynamic conditions ensure the stability of third-order extended heat conduction

Réka Somogyfoki², Péter Ván¹

¹Doctoral School of Physics, Eötvös Loránd University, Budapest, Hungary, ²HUN-REN Wigner Research Centre for Physics, Budapest, Hungary

We study the linear stability of homogeneous equilibrium in third-order extended heat conduction within the framework of non-equilibrium thermodynamics with internal variables. The thermodynamic state space is spanned by internal energy, heat flux, and a second-order tensor, and the constitutive structure is constrained by entropy concavity and non-negative entropy production. Linear stability analysis shows that, although additional constraints seem necessary in the most general case, classical thermodynamic conditions (concave entropy function and non-negative entropy production) are sufficient to guarantee thermodynamic stability. Several well-known heat conduction models are investigated as special cases, and the results support the interpretation of thermodynamics as an intrinsic stability theory and provide insight into the structure and limitations of higher-order transport models.

