

# New Frontiers in Non-Equilibrium Thermodynamics

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There are differences between the approach of continuum mechanics, kinetic theory, and the particle description. This is a main part of the Hilbert Sixth problem. Through concrete examples, we will explain this difference and the main idea of Rational Extended Thermodynamics both in the classical and relativistic framework. Finally, some thermodynamic aspects of similarity between gas mixtures and flocking and synchronization are presented.

[1] Ruggeri T., Sugiyama M.: Classical and Relativistic Rational Extended Thermodynamics of Gases; Springer: Cham (2021).

[2] Arima T., Carrisi M.C., Pennisi S., Ruggeri, T.: Relativistic Rational Extended Thermodynamics of Polyatomic Gases with a New Hierarchy of Moments. *Entropy*, 24(1), 43 (2022).

[3] Ha S.-Y., Ruggeri, T.: Emergent dynamics of a thermodynamically consistent particle model, *Arch. Ration Mech. Anal.*, 223:1397–1425, (2017).

[4] Ha S.-Y., Park H., Ruggeri T., Shim W.: Emergent behaviors of thermodynamic Kuramoto ensemble on a ring lattice. *J. of Stat. Phys.* 02611-2 (2020).