The Theory of Thermodynamic Relativity

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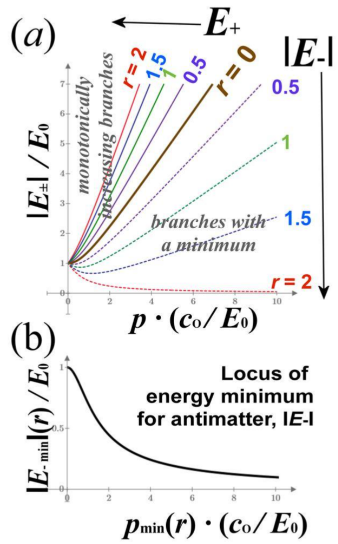


We introduce the theory of thermodynamic relativity, a unified theoretical framework for describing both entropies and velocities, and their respective physical disciplines of thermodynamics and kinematics, which share a surprisingly identical description with relativity.

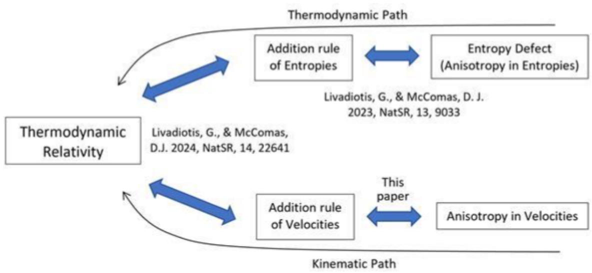
The journey to improve our understanding of the physical underpinnings of space thermodynamics has led to discovering new fundamental physics, including the concept of entropy defect, the generalization of the zeroth law of thermodynamics, and in this study, the development of thermodynamic relativity under a unified theoretical framework for describing both entropies and velocities.

This is the first study to generalize relativity in a thermodynamic context, leading naturally to anisotropic and nonlinear adaptations of relativity; thermodynamic relativity constitutes a new path of generalization, as compared to the "traditional" passage from special to general theory based on curved spacetime.

We show that entropy and velocity are characterized by three identical postulates, which provide the basis of a broader framework of relativity: (1) no privileged reference frame with zero value; (2) existence of an invariant and fixed value for all reference frames; and (3) existence of stationarity. The postulates lead to a unique way of addition for entropies and for velocities, called kappa-addition. We develop a systematic method of constructing a generalized framework of the theory of relativity, based on the kappa-addition formulation, which is fully consistent with both thermodynamics and kinematics.

We call this novel and unified theoretical framework for simultaneously describing entropy and velocity "thermodynamic relativity". From the generality of the kappa-addition formulation, we focus on the cases corresponding to linear adaptations of special relativity. Then, we show how the developed thermodynamic relativity leads to the addition of entropies in nonextensive thermodynamics and the addition of velocities in Einstein's isotropic special relativity, as in two extreme cases, while intermediate cases correspond to a possible anisotropic adaptation of relativity.

Using thermodynamic relativity for velocities, we start from the kappa-addition of velocities and construct the basic formulations of the linear anisotropic special relativity; e.g., the asymmetric Lorentz transformation, the nondiagonal metric, and the energy-momentum-velocity relationships. Then, we discuss the physical consequences of the possible anisotropy in known relativistic effects, such as, (i) matter-antimatter asymmetry, (ii) time dilation, and (iii) Doppler effect, and show how these might be used to detect and quantify a potential anisotropy.



References:

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