

**THE FOURTH LAW OF THERMODYNAMICS: THE IRREVERSIBLE COMPONENT OF
NONEQUILIBRIUM TIME EVOLUTION IS CHARACTERIZED BY A (DISSIPATIVE) METRIC
FIELD WHICH DEFINES THE DIRECTION OF STEEPEST ENTROPY ASCENT**

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ABSTRACT

When thermodynamics is understood as the science (or art) of constructing effective models of natural phenomena capable of capturing the essential features of the physical reality of interest, the scientific community has identified a set of general rules that the model must incorporate if it aspires to be consistent with the body of known experimental evidence. Some of these rules are believed to be so general that we think of them as laws of Nature, whose "greatness" derives from their generality, such as the great conservation principles and the second law of thermodynamics. In Ref. [1] we show that, in the past four decades, an enormous body of scientific research devoted to modeling the essential features of nonequilibrium natural phenomena has converged from many different directions and frameworks towards the general recognition (albeit still expressed in different but equivalent forms and language) that another rule is also indispensable and reveals another great law of Nature that we propose to call the "fourth law of thermodynamics." We state it as follows: every nonequilibrium state of a system or local subsystem must be equipped with a metric in state space with respect to which the irreversible component of its (local) time evolution is in the direction of steepest entropy ascent compatible with the (local) conservation constraints. In this presentation I will propose that, to qualify as "thermodynamic," a model of social, economic, human, biological, evolutionary behavior must conform to the fourth law.

Keywords: evolution, nonequilibrium, irreversibility

Reference:

[1] G.P. Beretta, The fourth law of thermodynamics: steepest entropy ascent, [arxiv.org/1908.05768](https://arxiv.org/abs/1908.05768)