

THERMODYNAMICS FOR EVOLUTION

Katalin Martinás

Budapest, Hungary

ABSTRACT

Modern thermodynamics is based on a canonized assumption that real non-equilibrium systems are constructed from inert elements. They are atoms in statistical thermodynamics, and local or cellular equilibria in phenomenological thermodynamics. In physics and chemistry this works well, but in biology and evolution studies this approach is problematic. The acquisition and maintenance of order in biological systems has been a conundrum of curiosity for many thinkers, including Schrödinger who proposed a controversial quantity - "Negative Entropy" in an attempt to formalize and better understand the complexity and thermodynamics of living systems. As it was perceived that there was no need for such a quantity in physics, the result was a torrent of criticism.

In this talk a holistic approach to thermodynamics will be presented, where the whole non-equilibrium system is characterized by global variables, yielding a new thermodynamic state variable (potential) called extropy that is zero in equilibrium, while in non-equilibrium states it is a measure of order. In this holistic non-equilibrium approach a set of new concepts appear, that are not present in the equilibrium approach. Energy is the sum of internal energy and active energy, the former is characterizing the microscopic state, while the latter is for describing the mesoscopic state. A first law formulated for non-equilibrium systems and the Carnot-thesis gives a general proof for the existence of entropy function.

The non-equilibrium state space has a Riemannian geometry, with a "thermodynamic" distance: the extropy. Extropy is a vector and its direction is important. Talking about biology, thermodynamic condition for survival formulated by extropy gives an inequality, which can be called the second law of living systems.

Keywords: evolution, extropy, non-equilibrium system, second law of living systems