Review of: "Comparison of extended irreversible thermodynamics and nonequilibrium statistical operator method with thermodynamics based on a distribution containing the first-passage time"

Michael Galperin[1]

1 University of California, San Diego

Potential competing interests: No potential competing interests to declare.

Manuscript compares several approaches to building thermodynamic description of nonequilibrium systems. Author compares distribution-based formulations containing first-passage time parameter (FTP), Zubarev's nonequilibrium statistical operator method (NSO), and extended irreversible thermodynamics (EIT) which uses flows as an additional thermodynamic parameter. The manuscript contains through description of each method. Comparing expressions for thermodynamic quantities (such as entropy) in different methods author draws conclusions about relations between different parameters involved in constructing the theories.

There are several points of potential confusion author may want to address in order to improve presentation of the study:

1. While technical part of the study is clear, the goal is less obvious. It would be useful to formulate clearly at the very start why such comparison is needed and, moreover, why it is expected to be meaningful (different theories are built on quite different, sometimes *ad hoc*, assumptions). Also, it would be helpful to explain why these particular theories are chosen for comparison, while many others are not considered.

2. Structure of the presentation can be improved. At present it is a bit chaotic: author jumps from one theory to another in sections comparing them. May be, first giving basics of each theory separately (different subsections) deriving all the necessary expressions for future comparisons in each subsection separately, and only after this starting technical comparison would benefit the flow of the presentation.

3. Another confusing point is related to basics of the theories to be compared. For example, NSO is inherently coarse grained technique, while FPT seems to be a stochastic formulation at its origin ("a statistical distribution is introduced containing a random lifetime or a random time when a random process reaches a certain level"). Does it mean that what really compared is coarse grained version of FPT and NSO? If true, then also question of role of coarse graining in the presented study should be addressed.