

Interactive comment on “Derivation of the entropic formula for the statistical mechanics of space plasmas” by George Livadiotis

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This is a review article and review articles most of times are like a binary variable, either 0 or 1. This paper is definitely “1” and deserves publication.

Kappa distributions have been used in Space plasma physics for more than half a century and even longer in other fields. It is well-known in literature that kappa distributions characterizing space plasmas can be linked to the so-called Tsallis entropy, a non-extensive entropic form that generalizes the classical Boltzmann-Gibbs entropy. The Tsallis entropy after maximization leads to the exact form of kappa distribution. However, this does not consist an actual proof or a justification for the use of kappa distribution, as the “natural” question then is what is the origin of this type of entropy.

This paper has a single, yet import cause, and that is to reply actually to the physical origin of the Tsallis entropy and thus the origin of Kappa distributions. This is achieved

by showing that Eq. (36) emerges by two assumptions, i.e., the extensivity of energy leading to Eq. (32), and the extensivity of entropy in Eq. (33). The combination of these equations leads to the differential equation given in Eq. (34), which is essentially the solution of Eq. (36).

I believe that this is very crucial, as it is the first time that a “rational” origin is given to the entropic form characterizing the particles in space plasmas that are described by kappa distributions. This single important result justifies the publication of the paper.

Finally, regarding the Tsallis entropy, I would like to comment that as a form it was introduced by Havrda & Charvát (1967) under the name “structural α -entropy”. I believe it is nice to mention that. Also, it is common in other fields, (information theory) the BG entropy to be named as Shannon entropy.

The rest of my comments are just typographical errors: (1) in “q-entropy” the “q” is sometimes in italics and sometimes not; (2) page 3/line 16: the BG acronym is given later in page 4; (3) sometimes the dash symbol is used instead of the minus symbol, e.g., page 6/line 18; (4) add spaces before and after “=”, e.g., page 7/line1; (5) in equation (35) maybe it is better to use $f(1)$ instead of $f(x=1)$ if I am not missing something.

Refs. Havrda, J., & Charvát, F. (1967). Concept of structural α -entropy. *Kybernetika*, 3, 30–35.

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Discussion paper

