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Statistical mechanics of non-extensive systems/Mécanique statistique des systèmes non-extensifs

Comment on the thematic issue "Statistical mechanics of non-extensive systems" [C. R. Physique 7 (3–4) (2006)]

Françoise Combes [a,*], Raoul Robert [b]

[a] *Observatoire de Paris, LERMA, 61, avenue de l'Observatoire, 75014 Paris, France*
[b] *Institut Fourier, UFR de mathématiques, université Grenoble 1, BP 74, 38402 Saint-Martin D'Hères cedex, France*

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The issue 3–4 of the 'Comptes rendus' of Physics this year (2006) contains articles on the statistical mechanics of non-extensive systems. This problem gives rise to controversies of which the reader could find an example in issue 2 of Europhysics News, 2006. The articles of the C. R. Physics issue very precisely put into question certain concepts which are not as universal as suggested by certain prejudices. The application of the principles of statistical mechanics to non-extensive systems is likely to disorient the uninformed reader. Indeed, for these systems, where the usually extensive quantities like energy or entropy are no longer proportional to the number N of particles, the canonical formalism of Gibbs is no longer justified, and there is no longer an equivalence between the canonical and microcanonical ensembles. The canonical distribution, which describes correctly any extensive system in equilibrium with a thermostat (or any finite system where the equilibrium with a thermostat could be realized), irreplaceable in the condensed matter physics, cannot be used here any more.

A large number of physical systems do not tend towards a homogeneous equilibrium state, but on the contrary towards increasingly complex, yet ordered structures, such as large eddies in the atmosphere of Jupiter, or the formation of fractal structures in the interstellar medium. The problems of non-extensivity occur with long-range interactions such as gravity. Research on non-extensive systems has the great merit of drawing attention to the importance of certain assumptions often made implicitly in statistical mechanics. One can hope that this will encourage the authors of handbooks to pass beyond these restrictions and to make a critical synthesis between traditional and new ideas. The C. R. Physique are ready to help them by publishing any article which could contribute to this clarification.

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* Corresponding author.
E-mail address: francoise.combes@obspm.fr (F. Combes).

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