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Definitions of temperature in non-extensive systems[1] SERGIO DAVIS, GONZALO GUTIÉRREZ, Departamento de Física, Facultad de Ciencias, Universidad de Chile — Superstatistics (Beck and Cohen, 2003) is a proposed formalism for explaining the presence of non-Boltzmann distributions in Nature for systems out of equilibrium. The superstatistical ensemble is a superposition of canonical ensembles according to

$$P(\vec{r},\vec{p}|H) = \int_0^\infty d\beta P(\beta|H) \frac{\exp(-\beta\mathcal{H}(\vec{\nabla}, \vec{\sqrt{}}))}{Z(\beta)}, \quad (1)$$

with $P(\beta|H)$ the probability density for the inverse temperature parameter β. In this work we show that, in order for this formalism to be internally consistent, it is impossible to have a definition of β as an observable which is valid across all "superstatistical" ensembles. In other words, the shape of the ensemble cannot be determined by measuring temperature, only by measuring energy. Our results also reveal the fact that energy and temperature are not in the same footing as observables for non-canonical ensembles.

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