

Nonadditive Entropies in Space Science and Turbulence

Constantino Tsallis^{1,2,3,4}

¹Centro Brasileiro De Pesquisas Físicas, Rio De Janeiro, Brazil, ²Santa Fe Institute, Santa Fe, USA, ³Complexity Science Hub, Vienna, Austria, ⁴Dipartimento di Fisica e Astronomia Ettore Majorana, Università di Catania, Catania, Italy

The entropic functional $S_{q,\delta}$ introduced in 2013 recovers the S_q and S_δ entropic functionals as particular cases, and consistently recovers also the Boltzmann–Gibbs (BG) entropic functional S_{BG} as its $(q, \delta) = (1, 1)$ particular instance. Arguments exist showing that the values of the indices (q, δ) corresponding to the thermodynamical limits of the microcanonical (isolated system) and canonical (long-standing thermal contact with an external thermostat) ensembles differ as soon as we depart from the BG limit. In the BG limit they of course coincide as proved in standard statistical mechanics textbooks for Hamiltonian many-body systems with short-range interactions. We illustrate this scenario through physical examples for S_q and for S_δ , related in particular with the d -dimensional area law and cosmological data as well as with turbulence. Bibliography at <https://tsallis.cbpf.br/biblio.htm>