Generalized statistical mechanics methods for superstatistical systems

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A review of the superstatistics concept is given. Many complex driven nonequilibrium systems are effectively described by a superposition of several statistics on different time scales, in short a 'superstatistics'. Superstatistical systems typically have marginal distributions that exhibit fat tails, for example power law tails or stretched exponentials. In most appliactions one finds three relevant universaliy classes: Lognormal superstatistics, chi-square superstatistics and inverse chi-square superstatistics. Superstatistical techniques can be applied to a variety of complex systems, for example turbulence (Lagrangian, Eulerian, environmental), hydroclimatic fluctuations, pattern formation, mathematical finance, traffic delay statistics, random matrix theory, networks, as well as medical and biological applications. In this talk I will deal with a generalized maximum entropy principle for superstatistical systems [1] and describe some applications in hydrodynamics [2], traffic dynamics [3], and medicine [4].

[1] S. Abe, C. Beck, E.G.D. Cohen, Superstatistics, thermodynamics, and fluctuations, Phys. Rev. E 76, 031102 (2007)

[2] C. Beck, Statistics of 3-dimensional Lagrangian turbulence, Phys. Rev. Lett. 98, 064502 (2007)

[3] K. Briggs and C. Beck, Modelling train delays with q-exponential functions, Physica A 378, 498 (2007)

[4] L. Leon Chen and C. Beck, A superstatistical model of metastasis and cancer survival, Physica A 387, 3162 (2008)