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Titulo: Time evolution of nonadditive entropies: The logistic map

Resumo:

The time dependence of entropy for all kinds of systems under all kinds of physical circumstances always thrives interest. This is due naturally to the second principle of thermodynamics, which basically states that the entropy of a closed large system always increases with time. The logistic map is neither large, since it has only one degree of freedom, nor closed, since it is dissipative. It exhibits, nevertheless, a peculiar time evolution of its natural entropy, which is the additive Boltzmann-Gibbs-Shannon one for all values of a for which the Lyapunov exponent is positive, and the nonadditive one at the edge of chaos, where the Lyapunov exponent vanishes. By averaging over the entire phase space, we numerically show that, for increasing time, the entropy overshoots above its stationary-state value in all cases. However, for the most chaotic case, the overshooting gradually disappears when the number of partitions of the phase space increases to infinity, whereas, at the Feigenbaum point, it appears, in remarkable contrast, to monotonically diverge in the same limit. Consequently, the stationary-state entropy value is achieved from above, instead of from below, as it could have been a priori expected. These results raise the question whether the usual requirements - large, closed, and for generic initial conditions - for the second principle validity might be necessary but not sufficient.