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Equilibria, scaling properties and intermittency as consequence of nonextensive duality in space plasmas: theory and observations

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Contrary to standard Boltzmann-Gibbs ensembles nonextensive statistics provides the proper theory for systems subject to nonlocal interactions, correlations and cross-scale couplings. As particular property, the associated entropy bifurcation governs both, the excess of small and large differences in the probability distributions of magnetic fields and plasma parameter fluctuations as compared to a Gaussian. The duality of meta-equilibria in nonextensive statistics is naturally manifest in a class of probability distributions, controlled by finite positive or negative values of the involved entropic index. The limiting Boltzmann-Gibbs state, subject to infinite entropic index, is characterized by self-duality. The nonextensive analysis of cross-scale coupling induced intermittency in the interplanetary medium is discussed in conjunction with in situ observations, demonstrating physically the characteristics of the redistribution of energy in turbulent plasma flows. Moreover, it is shown that nonextensive entropy bifurcation is fundamentally responsible also for the observed plasma density distributions in stellar gravitational equilibria.