Dynamics towards the Feigenbaum attractor

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As an essential component in the demonstration of an atypical, q-deformed, statistical mechanical structure in the dynamics of the Feigenbaum attractor we expose, at a previously unknown level of detail, the features of the dynamics of trajectories that either evolve towards the Feigenbaum attractor or are captured by its matching repellor. Amongst these features are the following: i) The set of preimages of the attractor and of the repellor are

embedded (dense) into each other. ii) The preimage layout is obtained as the limiting form of the rank structure of the fractal boundaries between attractor and repellor positions for the family of supercycle attractors. iii) The joint set of preimages for each case form an infinite number of families of well-defined phase-space gaps in the attractor or in the repellor. iv) The gaps in each of these families can be ordered with decreasing width in accord to power laws and are seen to appear sequentially in the dynamics generated by uniform distributions of initial conditions. v) The power law with log-periodic modulation associated to the rate of approach of trajectories towards the attractor (and to the repellor) is explained in terms of the progression of gap formation. vi) The relationship between the law of rate of convergence to the attractor and the inexhaustible hierarchy feature of

the preimage structure is elucidated. We discuss the function of these properties in the atypical thermodynamic framework existing at the period-doubling transition to chaos.

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