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Cosmology in One Dimension:Fractal Geometry, Power Spectra and Correlation

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Concentrations of matter, such as galaxies and galactic clusters, originated as very small density fluctuations in the early universe. The existence of galaxy clusters and super-clusters suggests that a natural scale for the matter distribution may not exist. A point of controversy is whether the distribution is fractal and, if so, over what range of scales. One-dimensional models demonstrate that the important dynamics for cluster formation occurs in the position-velocity plane. Here we investigate the development of scaling behavior and multifractal geometry for a family of one dimensional models for three different, scale-free, initial conditions. We show that hierarchical cluster formation depends sensitively on the initial power spectrum. Under special circumstances we confirm a simple relation between the power spectrum, correlation function, and correlation dimension.

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