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Effective spectral dimension in heterogeneous networks SUNGMIN

HWANG, Department of Physics and Astronomy, Seoul National University, DEOK-SUN LEE, Department of Natural Medical Sciences and Department of Physics, BYUNGNAM KAHNG, Department of Physics and Astronomy, Seoul National University — Random walks(RWs) approach is the simplest but the most fundamental method which encapsulates essential properties of diffusive dynamic process. Here, we study the two basic quantities, the return to origin probability and the first passage time distribution of random walks on scale-free networks. The behaviors of those quantities as a function of time typically depend on the spectral dimension d_s in disordered fractal systems. However, we show that in scale-free networks, due to the heterogeneity of connectivities of each node in scale-free networks, those quantities display a crossover decay behavior from $\sim t^{-d_s^{(\text{hub})}/2}$ in early time regime to $\sim t^{-d_s/2}$ in later time regime, where $d_s^{(\text{hub})} \rightarrow 0$ as the degree exponent λ approaches 2. This result implies that a random walker can be trapped effectively at the hub when $\lambda \rightarrow 2$. Next, we discuss the origin of the $d_s^{(\text{hub})}$ by applying the renormalization group transformation to deterministic hierarchical networks.

Sungmin Hwang
Department of Physics and Astronomy, Seoul National University

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