Condensed Matter > Statistical Mechanics

Fractal structure of a three dimensional Brownian motion on an attractive plane

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Consider a Brownian particle in three dimensions which is attracted by a plane with a strength proportional to some dimensionless parameter α. We investigate the fractal spatial structure of the visited lattice sites in a cubic lattice by the particle around and on the attractive plane. We compute the fractal dimensions of the set of visited sites both in three dimensions and on the attractive plane, as a function of the strength of attraction α. We also investigate the scaling properties of the size distribution of the clusters of nearest-neighbor visited sites on the attractive plane, and compute the corresponding scaling exponent τ as a function of α. The fractal dimension of the curves surrounding the clusters is also computed for different values of α, which, in the limit $\alpha\rightarrow\infty$, tends to that of the outer perimeter of planar Brownian motion i.e., the self-avoiding random walk (SAW). We find that all measured exponents depend significantly on the strength of attraction.

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