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Diffusion and self-avoiding walks on percolation clusters

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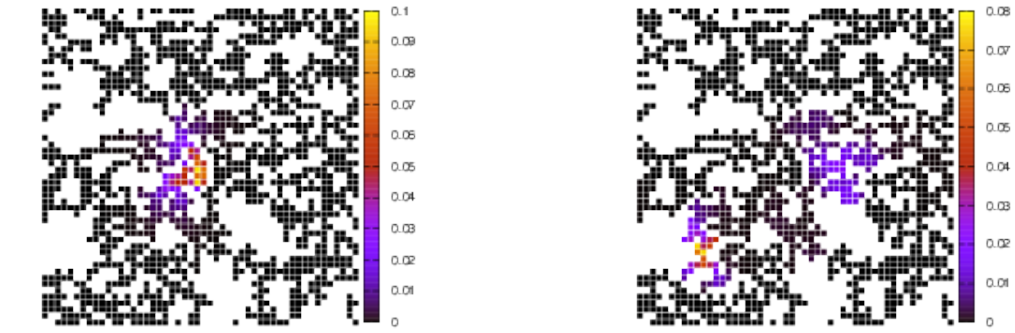
We study random walks (RWs) and self-avoiding random walks (SAWs) on critical percolation clusters as basic models for diffusion and polymers in disordered media [1, 2].

We employed a sophisticated algorithm that makes use of the self-similar structure of the critical clusters and allows exact enumeration of several thousand SAW steps, see [3].

For the SAW, one usually considers static averages over all trajectories (with uniform weights), whereas the RW is treated as a dynamical process. However, mean quantities for the RW such as the mean square displacement can be expressed as weighted averages over all trajectories, and the SAW can be described by a walker that is absorbed whenever he meets his own path or a defect site.

To complete the picture, we also investigate a dynamical version of the SAW, the so-called kinetic-growth self-avoiding walk (KGSAW), as well static averaging over all RW conformations, which describes the so-called ghost chain (GC).



a b

Figure 1: Probability distributions for the end-points of a random walk (a) and a self-avoiding walk (a) of 49 to 50 steps on a critical percolation cluster. (Starting location is in the center.)

In all cases, the asymptotic scaling behavior of the mean-square displacement is affected by the fractal nature of the critical clusters. However, while end-point distribution for the diffusive RW and the KGSAW spreads relatively evenly from the starting point, it tends to have a sharp peak in a dense cluster region for the GC and the SAW.

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References

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