Annealed bounds for the return probability of Simple Random Walk on finite critical percolation clusters

THU/AE01
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Critical Bernoulli percolation on a unimodular transitive graph and on the 2-dim. euclidean lattice has almost surely finite connected components. Estimating the expected return probability of the simple random walk is difficult, due to the heavy tails of the cluster-size distribution[1]. Annealed upper and lower bounds are presented and compared to the conventional technique: instead of only estimating the spectral gap, the whole spectrum of the graph Laplacian is involved. This leads to an improvement of the upper bound [2]. In the case of regular trees, this is good enough to distinguish the decay of the expected return probability on finite clusters from that on the incipient infinite cluster, as it is predicted by the Alexander-Orbach conjecture[3,4]. The proof involves using the property of cartesian products of finite graphs with cycles of a specific length to be Hamiltonian[5].

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5. V. Batagelj, T. Pisanski: 'Hamiltonian cycles in the cartesian product of a tree and a cycle', Discr. Math,. 38, 311-312, 1982