Anomalous transport in disordered iterated maps

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Anomalous diffusion is not only restricted to systems with many degrees of freedom. It is also observable in low dimensional systems such as random walks in random environments. Sinai diffusion characterises a class of random walks for which the so called Golosov phenomenon was proven rigorously. We extend the Sinai model to random walks whose transitions are not restricted to nearest-neighbours. Thereby a vanishing global bias is guaranteed by a generalisation of binary disorder.

For Sinai disorder exact results exist for the disorder averaged mean square displacement, the density of states of the propagator, and the size-dependence of the escape rate, or, the mean first passage time, respectively. For each of them one can define a characteristic exponent. We show that in our extension of the Sinai model these exponents also exist and seem to coincide. They show a non-trivial dependence on the system parameters. This is a consequence of the generic absence of detailed balance. Perturbation theory, which is exact in the Sinai case, enables to calculate escape rates for significant larger systems. For our extended model we find as function of system size a transition from a large preasymptotic regime to the asymptotic behaviour in dependence on the system parameters.