Intermittency for Branching Random walks with Heavy Tails

Asmaa Getan

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Abstract

Branching processes play important role in the study of the evolution of various population plants, where members of the population may die or produce offspring independently of the rest. They can be used to model reproduction of bacteria where each bacteria generates several offspring with some probability in a single time unit. And they can be used to model other systems with similar dynamics, e.g., the spread of surnames in genealogy or the propagation of neutrons in a nuclear reactor. In our dissertation, we consider a long time behavior for a model of branching random walk problem of a population of particles on the d- dimensional lattice. In this model, the number of particles increases exponentially by duplicating, with a constant rate of birth, (each particle can split into two particles), and the particles spread everywhere by jumping to not necessary a neighbor place, (it could be a faraway distance), under probability of jumps that is described to be, a heavy tailed probability. Branching or jumping of each particle occurs independently of the other particles. Under these two conditions, (constant rate of birth and heavy tailed probability of jumps), the front of propagation (where local growth occurs) has been found to be moving exponentially fast. A random field is called intermittent, if it is distributed very non-uniformly, where huge values can appear with a very small probability In our work, we found that particles on, and outside the front exhibit intermittent behavior. We proved that, the same is true for some region inside the front. Despite that the front of propagation itself moves exponentially fast, the front of intermittency moves with a small power rate inside the first front. This rate has been found exactly.

Department of Mathematics, UNC Charlotte, Charlotte, NC 28223