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Discrete SIR Epidemic Processes and their Relation to Extreme Values of Branching Random Walk

We study the behavior of spatial SIR epidemic models in dimensions two and three. In these models, populations of size N are located at sites of the d -dimensional lattice, and infections occur between individuals at the same or at neighboring sites with infection probability p_N . Susceptible individuals, once infected, remain contagious for one unit of time and then recover, after which they are immune to further infection. We answer the question which was raised in Lalley, Perkins and Zheng (2014) and prove that there exist critical values $p_c(N) > 0$ such that for N large enough, if $p_N > p_c(N)$, then the epidemic survives forever with positive probability. When $p_N < p_c(N)$ we prove that the epidemic dies out in finite time with probability 1.

The behavior of extreme values of branching random walk is a key ingredient in the proof of phase transitions. In this context, we prove that the support of the local time of supercritical branching random walk near criticality, grows in a linear speed. Finally the tail behavior for the right most position reached by subcritical branching random walk is derived.

This is joint work with Xinghua Zheng.