Multiple phase transitions in long-range first-passage percolation on square lattices.

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Resumo/Abstract:
We consider a model of long-range first-passage percolation on the d-dimensional square lattice in which any two distinct vertices x, y are connected by an edge having exponentially distributed passage time with mean $|x-y|^s$, where $s>0$ is a fixed parameter and $||$ is the l_1–norm on Z^d. We analyze the asymptotic growth rate of the set B_t, which consists of all $x \in Z^d$ such that the first-passage time between the origin 0 and x is at most t, as $t \to \infty$. We show that depending on the values of s there are four growth regimes:

- (i) instantaneous growth for $s < d$,
- (ii) stretched exponential growth for $s \in (d, 2d)$,
- (iii) superlinear growth for $s \in (2d, 2d+1)$ and finally
- (iv) linear growth for $s > 2d+1$ like the nearest-neighbor first-passage percolation model corresponding to $s = \infty$.

We find explicit growth rates and also analyze the behavior at the boundary values $s = d, 2d, 2d+1$. Finally, we find the asymptotic distribution of the passage time in one-dimension for different values of s. Based on joint work with Shirshendu Chatterjee.