Branching Random Walks in Random Environment: Diffusive Behavior and Localization

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This talk is based in part on a joint work with Yueyun Hu (Paris XIII). We consider branching random walks in d-dimensional integer lattice with time-space i.i.d. offspring distributions. We analyze the density field at time t:

$$\rho_{t,x} = (\text{population at location } x)/(\text{total population})$$

and the replica overlap:

$$\mathcal{R}_t = \sum_x \rho_{t,x}^2.$$

We report on the following localization/delocalization transition of this model. If $d \geq 3$ and the environment is "not too random", then, the density satisfies a central limit theorem, and the replica overlap decays like $t^{-d/2}$ (diffusive behavior, delocalization). If, on the hand, $d \leq 2$, or the environment is "random enough", then the overlap takes larger values than a certain non-random positive number infinitely often (localization).