Often emerging features in birth-death processes cannot be directly estimated from the elementary interactions of their microscopic individual components. We analyzed a simple catalyst induced birth death process and have shown that its behavior is qualitatively very different from the behavior expected from equations acting on spatially continuous density distributions. We find that in conditions in which the continuum approach would predict the extinction of all of the population, the microscopic granularity insures the emergence of macroscopic localized subpopulations with collective adaptive properties that allow their survival and development. In particular it is found that in two dimensions “life” (the localized proliferating phase) always prevails \(^1\) \(^2\) \(^3\) \(^4\).

When non-local competition is introduced to the same system, an extreme localization of the agents emerges, where typically a single aggregate of agents can survive within a given competition radius. The survival of these aggregates is determined by the diffusion rates of the agents and the catalysts. For high and low agent diffusion rates, the agent population is always annihilated, while for intermediate diffusion rates, a finite agent population persists \(^5\) \(^6\).

When a feedback between the catalyst and the reactant is introduced to the same system, a second order survival-extinction appears which replace the first order transition expected in the parallel partial differential equation\(^7\).


