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Escape and Finite-Size Scaling in Diffusion-Controlled Annihilation ELI BEN-NAIM, Los Alamos National Laboratory, PAUL KRAPIVSKY, Boston University — We study diffusion-controlled single-species annihilation with a finite number of particles. In this reaction-diffusion process, each particle undergoes ordinary diffusion, and when two particles meet, they annihilate. We focus on spatial dimensions $d > 2$ where a finite number of particles typically survive the annihilation process. Using scaling techniques we investigate the average number of surviving particles, M, as a function of the initial number of particles, N. In three dimensions, for instance, we find the scaling law $M \sim N^{1/3}$ in the asymptotic regime $N \gg 1$. We show that two time scales govern the reaction kinetics: the diffusion time scale, $T \sim N^{2/3}$, and the escape time scale, $\tau \sim N^{4/3}$. The vast majority of annihilation events occur on the diffusion time scale, while no annihilation events occur beyond the escape time scale.

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