# LONG TIME TAILS IN DIFFUSION-CONTROLLED RECOMBINATIONS

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**Abstract.** Recently, much attention has been paid to slow asymptotic relaxation in simple diffusion-controlled recombination processes. Below an upper critical dimension $d_c$, particle densities $\rho(t)$ exhibit nonanalytic decay in the long time limit $t \to \infty$. Typical examples are

$$\mathrm{A} + \mathrm{A} \to \emptyset \ :$$

$$\rho_A(t) \propto t^{-d/2} \qquad (d < d_c = 2), \tag{1}$$

$$\mathrm{A} + \mathrm{B} \to \emptyset \qquad (\rho_A(0) = \rho_B(0)) \ :$$

$$\rho_A(t) = \rho_B(t) \propto t^{-d/4} \qquad (d < d_c = 4), \tag{2}$$

$$\mathrm{A} + \mathrm{B} \to \emptyset \qquad (\rho_A(0) < \rho_B(0)) \ :$$

$$\rho_A(t) \propto \exp[-t^{d/2}] \qquad (d < d_c = 2). \tag{3}$$

These behaviors are investigated on the basis of a field theoretical renormalization group technique where initial conditions are taken into account explicitly. It becomes evident that the method is a powerful tool in understanding these phenomena systematically. Complete scaling relations are derived and concrete forms of scaling functions are calculated. Logarithmic corrections at $d = d_c$ are also discussed.