

# Numerical experiments on noisy chains: From collective transitions to nucleation-diffusion

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**Abstract-** We consider chains of particles with nearest-neighbor coupling, independently subjected to noise, all initially in the same well of a symmetric double-well potential. If there are sufficiently few particles, transitions from one well to another are **collective**; i.e., all particles remain close together as they make the passage from one well to the other. In longer chains, only a fraction of the particles make an initial transition, creating a nucleated region that may grow or collapse by diffusion of its boundaries. Numerical experiments are used to explore the change of the scaling of the passage time as a function of the length of the chain, which distinguishes the two regimes. A suitable relationship between the noise amplitude, coupling, and number of particles in the chain yields convergence to the continuum  $\phi^4$  or Allen-Cahn stochastic partial differential equations in one space dimension. We estimate the characteristic width of newly nucleated regions and construct a numerical effective potential describing the dynamics in the nucleation-diffusion regime.

**Index Terms-** Stochastics, nucleation, passage time

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