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Asymptotics for stochastic reaction-diffusion equation driven by subordinate Brownian motion

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Abstract

We study the ergodicity of stochastic reaction-diffusion equation driven by subordinate Brownian motion. After establishing the strong Feller property and irreducibility of the system, we prove the tightness of the solution's law. These properties imply that this stochastic system admits a unique invariant measure according to Doob's and Krylov-Bogolyubov's theories. Furthermore, we establish a large deviation principle for the occupation measure of this system by a hyper-exponential recurrence criterion. It is well known that S(P)DEs driven by α-stable type noises do not satisfy Freidlin-Wentzell type large deviation, our result gives an example that strong dissipation overcomes heavy tailed noises to produce a Donsker-Varadhan type large deviation as time tends to infinity.

Keywords: Stochastic reaction-diffusion equation; Subordinate Brownian motions; Large deviation principle; Occupation measure.

Mathematics Subject Classification (2000): 60F10, 60H15, 60J75.

1 Introduction

Consider a stochastic reaction-diffusion equation driven by subordinate Brownian motion on torus $\mathbb{T} := \mathbb{R}/\mathbb{Z}$ as follows:

$$\mathrm{d}X - \partial_\xi^2 X \mathrm{d}t - (X - X^3)\mathrm{d}t = Q_\beta \mathrm{d}L_t, \tag{1.1}$$

where $X : [0, +\infty) \times \mathbb{T} \times \Omega \to \mathbb{R}$ and L_t is a subordinate cylinderical Brownian motion. More details about this equation will be given in the next section. Sometimes the equation (1.1) is also called stochastic Allen-Cahn equation or real Ginzburg-Landau equation. Recently, the study of invariant measures and the long time behavior of stochastic partial differential equations (SPDEs) driven by α-stable type noises has been extensively studied, we refer to [4, 5, 7, 10, 11, 18, 21, 22, 29] and the literatures therein.

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