Long-Time Behavior of Some Stochastic Evolution Equations on the Sphere and Their Numerical Discretizations

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Abstract

We study the stochastic wave and stochastic free Schrödinger equations on the unit sphere $\mathbb{S}^2$, driven by a mean-zero square-integrable additive Q-Lévy noise. We show linear growth of the expected energy for both equations, as well as of the expected mass for the stochastic Schrödinger equation. We further investigate the long-time behavior of these quantities in the exponential Euler, Euler–Maruyama and backward Euler–Maruyama time-stepping schemes. While the exponential Euler method recovers the correct linear growth, the Euler–Maruyama and backward Euler–Maruyama exhibit too fast and too slow growth, respectively. Our theoretical predictions are confirmed through numerical experiments. This is joint work with David Cohen and Andrea Papini.