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*Diffusion-driven dynamics in bistable reaction-diffusion systems: Beyond Turing Instabilities*

Bistability is a key feature in reaction-diffusion (RD) systems, enabling the coexistence of two stable equilibrium states and driving complex spatiotemporal behaviors; such as traveling waves, oscillatory pulses, and spatial patterns. While traditional analyses often focus on diffusion-driven instabilities (commonly known as Turing instability) arising from a uniform stable steady state, this study investigates the effect of diffusion on general steady states and limit cycles within a bistable reaction-diffusion system.

Using numerical simulations, we analyze how diffusion influences an ODE system exhibiting different dynamical behaviours; including stable steady state dynamics, bistable dynamics, limit cycle dynamics, and coexistence between uniform steady states and limit cycles.

In this talk, I will present a two-species reaction-diffusion model whose reaction kinetics are derived from first principles based on experimental observations. I will describe the model formulation and highlight key temporal dynamics of the model in the absence of diffusion. I will thereafter describe diffusion-driven transitions, such as spatial pattern formation and migration between steady states and migration of limit cycle in parameter regions far from classical Turing scenarios.