Boundary Effects in Stochastic Cyclic Competition Models on a Two-Dimensional Lattice

M. Lazarus Arnau, Shannon Serrao, Uwe C. Täuber

Department of Physics,
Virginia Polytechnic Institute and State University

March 7, 2019

Introduction

Motivations in Biology and Chemistry

- Reproductive strategies in side-blotched lizards
- Experiments involving *E. coli*
- Belousov-Zhobotinsky Reaction

Models

- Rock-Paper-Scissors (RPS) Model:

$$\text{(Replacement) } X_n X_{n+1} \xrightarrow{\zeta} X_n X_n$$
$$\text{(Diffusion) } XY \xrightarrow{\epsilon_r} YX$$

- May-Leonard (ML) Model:

$$\text{(Predation) } X_n X_{n+1} \xrightarrow{\sigma} X_n \varnothing$$
$$\text{(Reproduction) } X\varnothing \xrightarrow{\mu} XX$$
$$\text{(Diffusion) } XY \xrightarrow{\epsilon_m} YX$$

Models (cont.)

Insert images of typical behavior.

Simulations

- Toroidal topology
- 256×512 lattice
- Primarily ML model
- RPS implemented in a narrow (64 cell) strip.

Insert renders of the plane-waves.

Density Effects

Insert vertical density graph
Insert vertical reaction rate graphs

Permeation length

Insert renders of spectrographs

Vertical Correlation Lengths

Insert vertical correlation function graphs