IRREVERSIBLE PHASE TRANSITIONS IN A FOUR-SPECIES PREDATOR-PREY MODEL

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In this work we investigate a spatial predator-prey model with competing interactions and site exchange [1]. Here, four species interact cyclically ($1 \to 2 \to 3 \to 4 \to 1$) with invasion probability p_1 while the pairs $2 \to 4$ and $3 \to 1$ interact with probability p_2. Different species in neighboring sites are allowed to exchange their positions with probability p_m. By applying conventional Monte Carlo simulations and the Gradient Method [2] we obtained the complete model's phase diagram which presents phases composed by two, three or four coexisting species. The nature of the irreversible phase transitions between the absorbing two-species and the active three- and four-species phases as well as between the active ones were studied. Independent on the involved phases, all the transitions seem to be of first-order. This result is in accordance with that in a previous work [2] in which the continuous phase transitions were suppressed by the mixing imposed by the nonzero exchange p_m.

[1] G. Szabó and A. Szolnoki, Phys. Rev. E, **77**, 011906 (2008).

[2] N. C. Guisoni, E. S. Loscar and M. Girardi, Phys. Rev. E, **88**, 022133 (2013).