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Effects of Spatial Diffusion on a Model for Prebiotic Evolution

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In previous work (Physical Review E 89, 022725 (2014)), a Kauffman-like model for prebiotic evolution was used to explore the effects of requiring that the final steady states generated
be out of chemical equilibrium. That constraint, consistent with intuitive ideas of the meaning of 'lifelike', had a significant impact on the probability of the appearance of lifelike states in the model. The model assumed that the constituent 'molecules' were in a 'well-mixed' reactor so that effects of spatial diffusion played no role. I will review that earlier work and describe our present studies in which spatial heterogeneity and spatial diffusion are introduced. The competition between chemical reaction and diffusion leads to various kinds of nonequilibrium steady states, some spatially equilibrated but out of chemical equilibrium, some chemically equilibrated but out of spatial equilibrium and still others, perhaps the most lifelike, which are not equilibrated in either way but are in dynamic steady states far from equilibrium. Using data from simulations that were performed on the Open Science Grid, I will present estimated probabilities of the generation of these various kinds of states as a function of the two parameters of the model (Physical Review E 94 (4), 042424 (2016)).

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