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Stochastic evolution of four species in cyclic competition: exact and simulation results[1] SARA CASE, CLINTON DURNEY, MICHEL PLEIMLING, R.K.P. ZIA, Virginia Tech — We study a stochastic system with N individuals, consisting of four species competing cyclically: $A + B \longrightarrow A + A$, $\cdots$, $D + A \longrightarrow D + D$. Randomly choosing a pair and letting them react, N is conserved but the fractions of each species evolve non-trivially. At late times, the system ends in a static, absorbing state − typically, coexisting species AC or BD. The master equation is shown and solved exactly for $N = 4$, providing a little insight into the problem. For large N, we rely on simulations by Monte Carlo techniques (with a faster dynamics where a reaction occurs at every step). Generally, the results are in good agreement with predictions from mean field theory, after appropriate rescaling of Monte Carlo time. The theory fails, however, to describe extinction or predict their probabilities. Nevertheless, it can hint at many remarkable behavior associated with extinction, which we discover when studying systems with extremely disparate rates.

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