

Abstract Submitted  
for the MAR11 Meeting of  
The American Physical Society

**Stochastic evolution of four species in cyclic competition: exact and simulation results**<sup>1</sup> S.O. CASE, C.H. DURNEY, M. PLEIMLING, R.K.P. ZIA, Virginia Tech — We study a stochastic system with  $N$  individuals, consisting of four species competing cyclically:  $A + B \rightarrow A + A$ ,  $\dots$ ,  $D + A \rightarrow D + D$ . 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.

<sup>1</sup>Supported in part by NSF-DMR-0705152, 0904999, 1005417.

Michel Pleimling  
Virginia Tech

Date submitted: 12 Nov 2010

Electronic form version 1.4