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**Emergence of Rapid Evolution from Demographic Stochasticity**

HONG-YAN SHIH, NIGEL GOLDENFELD, Department of Physics, University of Illinois at Urbana-Champaign — The phenomenon of "rapid evolution" arises when genetic variation occurs fast enough to significantly change ecodynamics. Data from experiments with algae-rotifer system and bacteria-phage system show unusual dynamics when there are subpopulations of preys with different trait values, including predator-prey phase shifts near $\pi$ (and distinct from the canonical value of $\pi/2$) and so-called cryptic cycles, in which populations of preys remain constant while the predator population oscillates. Such phenomena have been modeled with deterministic differential equations containing empirical Michaelis-Menten kinetic terms and the unusual dynamics that is attributed to postulate complicated trade-off between sub-populations. Here we present a generic individual-level stochastic model of interacting populations that includes a subpopulation resistant to the predator but with metabolic cost. We solve this model by using a master equation approach, and by performing system size expansion, we find that antiphase and cryptic quasi-cycles can emerge from the combination of intrinsic demographic fluctuations and clonal mutations alone. These analytic results are then compared with Gillespie simulations, and the typical phase diagram of the system is calculated.

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