EMERGENCE OF RAPID EVOLUTION FROM DEMOGRAPHIC STOCHASITICITY. Hong-Yan Shih and Nigel Goldenfeld, Loomis Laboratory of Physics, Department of Physics, Center for the Physics of Living Cells and Institute for Genomic Biology, University of Illinois at Urbana-Champaign.

Introduction: The phenomenon of "rapid evolution" arises when genetic variation occurs fast enough to significantly change ecological dynamics. Data from experiments with bacteria-phage system and algae-rotifer system show anomalous dynamics when there are subpopulations of preys with different trait values, including evolutionary cycles with predator-prey phase shifts near π (and distinct from the canonical value of $\pi/2$) and cryptic cycles with even undetectable prey oscillations compared to those of the predator. Such phenomena have been modeled with deterministic differential equations containing empirical Michaelis-Menten kinetics and unusual dynamics terms that are 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, without additional biological mechanisms. These analytic results are then compared with stochastic Gillespie simulations, and the typical phase diagram of the system incorporating estimation of extinction risk is calculated [1].

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References:

[1] Shih H. and Goldenfeld N. (2014) *Phys. Rev. E, 90,* 050702-050707.