Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Population genetics with selection on multiple phases of microbial growth MICHAEL MANHART, BHARAT ADKAR, EUGENE SHAKHNOVICH, Harvard University — Microbial populations undergo multiple stages of growth, including a lag phase, an exponential growth phase, and a stationary phase. Both laboratory and wild populations may experience multiple cycles of these growth dynamics as they explore new environments, or new resources become available. Mutations typically have pleiotropic effects on multiple phases of growth, and the evolutionary fate of these mutations may depend on all of these effects. We use a simple model of population growth to quantify how selection acts on these different growth phases. The model shows how tradeoffs between the phases can give rise to complex population dynamics including frequency-dependent selection, stable and unstable coexistence of multiple strains, and non-transitive selection, where the very notion of a fitness landscape breaks down. In particular, the model predicts how to tune the competition conditions to alter the balance of these tradeoffs. We compare these results to growth data on E. coli strains having mutations in the enzyme adenylate kinase. These strains show evidence of such tradeoffs, which we verify in direct competition experiments.

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Date submitted: 09 Nov 2016 Electronic form version 1.4