Abstract Submitted for the MAR12 Meeting of The American Physical Society

Bacterial Cheating Limits the Evolution of Antibiotic Resistance<sup>1</sup> EUGENE YURTSEV, HUI XIAO CHAO, Department of Physics, Massachusetts Institute of Technology, MANOSHI DATTA, Computational and Systems Biology, Massachusetts Institute of Technology, TATIANA ARTEMOVA, JEFF GORE, Department of Physics, Massachusetts Institute of Technology — The emergence of antibiotic resistance in bacteria is a significant health concern. Bacteria can gain resistance to the antibiotic ampicillin by acquiring a plasmid carrying the gene betalactamase, which inactivates the antibiotic. This inactivation may represent a cooperative behavior, as the entire bacterial population benefits from removal of the antibiotic. The presence of a cooperative mechanism of resistance suggests that a cheater strain - which does not contribute to breaking down the antibiotic - may be able to take advantage of resistant cells. We find experimentally that a "sensitive" bacterial strain lacking the plasmid conferring resistance can invade a population of resistant bacteria, even in antibiotic concentrations that should kill the sensitive strain. We use a simple model in conjunction with difference equations to explain the observed population dynamics as a function of cell density and antibiotic concentration. Our experimental difference equations resemble the logistic map, raising the possibility of oscillations or even chaotic dynamics.

<sup>1</sup>This research was supported by the National Science Foundation Graduate Research Fellowship under Grant no. 0645960.

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Date submitted: 08 Dec 2011

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