Abstract Submitted
for the MAR08 Meeting of
The American Physical Society

On the Selection of Bistability in Genetic Regulatory Circuits
CHEOL-MIN GHIM, EIVIND ALMAAS, Lawrence Livermore National Laboratory, MICROBIAL SYSTEMS BIOLOGY TEAM — Bistability is a defining character of switching and memory devices. Many regulatory circuits observed in cellular reaction networks contain "bistability motifs" that endow a cell with efficient and reliable switching between different physiological modes of operation. One of the best characterized system, the *lac* operon in *E. coli*, has been shown to display a saddle-node bifurcation when induced by nonmetabolizable lactose analogue inducers, such as isopropylthio-β-D-galactoside (IPTG) and thio-methyl-galactoside (TMG). Motivated by the absence of bifurcation in the same system with its natural inducer, lactose, we studied the conditions for bistability and rationalized its fitness effects in the light of evolution. Stochastic simulations as well as mean-field approach confirm that history-dependent behavior as well as nongenetic inheritance, being realized by bistability motifs, may be beneficial in fluctuating environments.

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Date submitted: 26 Nov 2007 Electronic form version 1.4