

Abstract Submitted
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Adiabatic and Non-Adiabatic Non-Equilibrium Stochastic Dynamics of Single Regulating Genes HAIDONG FENG, BO HAN, JIN WANG, Department of Chemistry, State University of New York at Stony Brook — We explore the stochastic dynamics of self regulative genes from fluctuations of molecular numbers and of on and off switching of gene states due to regulatory protein binding/unbinding to the genes. We found when the binding/unbinding is relatively fast (slow) compared with the synthesis/degradation of proteins in adiabatic (non-adiabatic) case, the self regulators can exhibit one or two peak (two peak) distributions in protein concentrations. This shows even with the same architecture (topology of wiring), networks can have quite different functions (phenotypes), consistent with recent single molecule single gene experiments. We derive the non-equilibrium phase diagrams of mono-stability and bi-stability in adiabatic and non-adiabatic regimes. We study the stability and robustness of the systems through mean first passage time (MFPT) from one peak (basin of attraction) to another. In addition, using the new method for quantifying the paths and the associated weights for complex systems in discrete state space (Markov chains), we identified the dominant paths among all possible paths from the “off” basin to the “on” basin for self-activators, and observe turnover kinetic behavior of transitions and MFPT from non-adiabatic to adiabatic regimes.

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