Abstract Submitted
for the MAR07 Meeting of
The American Physical Society

Stochastic effects in reaction networks ARYEH WARMFLASH, AARON DINNER, University of Chicago — Experiments that yield information about single cells make clear that intrinsic noise in reactions involving low copy numbers of molecules can have important functional consequences. Although it is typically assumed that noise introduces isotropic fluctuations about a mean, this need not be the case. Within the Langevin framework, we develop "rules of thumb" for understanding the impact of noise on systems of reactions. We show analytically how increases in either the magnitude or correlation time of fluctuations can give rise to amplifications and bifurcations. As an example, we consider the enzymatic cycle studied by Goldbeter and Koshland. Fluctuations in the total number of enzyme for the forward reaction have been shown to amplify the concentration of the modified substrate and can even create additional peaks in its distribution. We show how our results lead to a transparent physical interpretation of these observations, and we clarify how ultrasensitivity, amplification, bifurcation, and stochastic focusing relate to each other.

Aryeh Warmflash
University of Chicago

Date submitted: 20 Nov 2006 Electronic form version 1.4