Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

New chemical kinetics for description of chemical noise in small, heterogeneous biological systems: Beyond the paradigm of the rate constant concept[1] JAEYOUNG SUNG, Chung-Ang University — We introduce a novel chemical kinetics for quantitative description of chemical fluctuations in a small, heterogeneous biological reaction system. At first, we discuss the recently proposed renewal chemical kinetics, and its application to quantitative interpretation of the randomness in fluctuating enzymatic turnover times of a-galactosidase. From the analysis of the randomness parameter data of the single enzyme reaction, one can extract valuable quantitative information about the enzyme reaction system, beyond the reach of the conventional Michaelis-Menten analysis. Next, we discuss a new universal behavior in the time dependence of the chemical fluctuation of product density for a small, heterogeneous reaction system, which is predicted from an exact analytic study for a general reaction model and confirmed by stochastic simulation results. We also discuss the dependence of the chemical noise on substrate concentrations for a heterogeneous enzyme reaction system, which turns out qualitatively different from that for a homogeneous enzyme reaction system.

[1]Nation Research Foundation of Korea

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Date submitted: 26 Oct 2011 Electronic form version 1.4