



## Berlin Center for Studies of Complex Chemical Systems e. V.

Fritz-Haber-Institut der Max-Planck-Gesellschaft, Humboldt-Universität,  
Max-Delbrück-Centrum für Molekulare Medizin, Otto-von-Guericke-Universität  
Magdeburg, Physikalisch-Technische Bundesanstalt, Technische Universität  
Berlin, Universität Potsdam

## Seminar

### Complex Nonlinear Processes in Chemistry and Biology

Honorary Chairman: G. Ertl

Organizers: M. Bär, C. Beta, H. Engel, M. Falcke, M. J. B. Hauser, A.  
S. Mikhailov, P. Plath, L. Schimansky-Geier, H. Stark

Friday, 15th April 2011, 16:00 s.t.

### Dr. Masayo Inoue

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### Dynamics of Adaptive Responses in Biological Systems

#### Abstract

Adaptation is one of the most common properties of biological organisms, observed at their different levels. The best known examples correspond to the adaptation on the evolutionary scale, achieved through mutations and selection. Here, we focus however on the adaptive responses on the shorter time scales, corresponding to the response of an organism to environmental changes within its lifetime. Habituation dynamics in the new environment as an adaptive response at the cellular level is considered. The emphasis is on the adaptive responses involving multiple degrees of freedom.

We have studied the dynamics of a model of coupled adaptive elements which is analogous to the intracellular signal transduction system. The behaviors of the model with a small number of elements, depending on the structure of the interactions network between the elements, have been classified and applicability of the results to the systems with larger numbers of elements has been considered [1]. Furthermore, the emergence of adaptive responses to environmental changes through an evolutionary process has been investigated by using a gene regulation model with multiple degrees of freedom. It has been found that, even if the adaptive response for the expression of only one target gene is postulated, the expressions of many genes start to show adaptive behavior through the evolution. The mechanisms of such “cooperative adaptive responses” shall be discussed.

#### References:

[1] M. Inoue and K. Kaneko, Phys. Rev. E 81, 026203 (2010)

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