The 37th iCeMS SEMINAR

CeMI Seminar Series 11

Mon 30 Nov 2009

15:00-16:00

Lecturer: **Dr. Kiyoshi Mizuuchi**
National Institutes of Health (NIH)
U. S. A.

Multiple Inter-Converting Modes of ATP-Driven Self-Organized Dynamic Pattern Formation by Bacterial Cell Division Proteins

Venue: Conference Room (#119)
1st Floor of the Research Building 1
iCeMS Complex 2, Kyoto University

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Hosted by: iCeMS (Institute for Integrated Cell-Material Sciences), Kyoto University

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Abstract of the seminar by Dr. Mizuuchi on Nov. 30

Min proteins of the *Escherichia coli* cell division system oscillate between the cell poles *in vivo*. The system involves MinC, MinD and MinE proteins. MinC is an inhibitor of FtsZ polymerization on the membrane, which initiates the assembly of the cell division septum. MinC distribution on the membrane is dictated by MinD to which it binds. MinD is an ATP-dependent membrane binding protein, and MinE stimulates MinD ATPase. Together, the oscillating system generates time-averaged distribution minima of MinC at mid-cell, assuring the cell division takes place at mid-cell. While MinC links the MinD distribution to the location of the septum, it is dispensable for the MinD/E oscillation.

In vitro, on a lipid bi-layer surface, MinD/E proteins exhibit a number of interconverting modes of collective ATP-driven dynamic pattern formation including not only the previously described propagating waves, but also near uniform-in-space surface concentration oscillation, propagating filament-like structures with a leading head and decaying tail, and moving and dividing amoeba-like structures with sharp edges. We demonstrate that the last behavior most closely resembles *in vivo* system behavior. The simple reaction-diffusion models previously proposed for the Min system fail to explain the results of *in vitro* self-organization experiments. We propose hypotheses that initiation of MinD binding to the surface is controlled by counteraction of initiation and dissociation complexes; the binding of MinD is stimulated by MinE and involves polymerization-depolymerization dynamics; polymerization of MinE over MinD oligomers triggers dynamic instability leading to detachment from the membrane.

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Fig. 1. MinD (green) and MinE (red) wave transforms into running and dividing amoebas. Frames were taken every 40 s, the scale bar is 5 μm.