iCeMS-iTHEMS Joint Workshop on Interdisciplinary Biology

Wednesday 4 Jul 2018, 10:00 → 16:30 Asia/Tokyo

204-205 (SUURI-COOL (Kyoto))

Daniel Packwood (iCeMS, Kyoto Univ.) , Tetsuo Hatsuda (RIKEN iTHEMS)

Description

This is the first joint workshop between iCeMS (Kyoto Univ.) and iTHEMS (RIKEN). The WS is also co-hosted by KUIAS (Kyoto Univ.) and MACS Program (Kyoto Univ.).

By exploring the forefront of experimental and mathematical biology, this workshop aims to stimulate novel research directions in these areas and strengthen the connection between Kyoto Univ. and RIKEN.

Date/Time: July 4, 2018. 10:00-16:30 (WS), 18:00-20:00 (get-together)

Venue: room 201, 2F in Maskawa Building (No.13), North Campus, Kyoto Univ.

Registration from the bottom of this page.

Those who plan to attend the "get-together", please register before June 22 (Fri.) noon.

PROGRAM

[Opening]

10:00-10:10 Shigefumi Mori **(KUIAS)** "Opening address"

10:10-10:20 Daniel Packwood **(iCeMS)** "Introduction to iCeMS"

10:20-10:30 Tetsuo Hatsuda **(iTHEMS)** "Introduction to iTHEMS"

[Session 1]

10:30-11:00 Jun Suzuki **(iCeMS)**

"Phospholipid scrambling on the plasma membranes"

Abstract: Phospholipid on plasma membranes are asymmetrically distributed. For instance, phosphatidylserine (PS) locates mainly at the inner side of the membranes, but is exposed on the cell surface in some physiological situations. The proteins involved in this process were called scramblases, but their molecular identity has been unknown for decades. In this talk, I will talk about the scramblases which we have identified and mechanisms of phospholipid scrambling.

11:00-11:30 Masashi Tachikawa **(iTHEMS)**

"Self-organization of Golgi apparatus"

Abstract: Golgi apparatus is a membrane-bound organelle with characteristic morphology and important functional role in membrane trafficking. Using physical simulation, we reconstructed reassembly process of Golgi apparatus observed in mammalian cell division and revealed self-organizing properties of the process.

[Lunch]

[Session 2]

13:00-13:30 Dan Ohtan Wang **(iCeMS)**

"Spatiotemporal regulation of gene expression in neurons"

Abstract: The function of the brain arises from the complex geometry of neurons. Such geometry is essential for neuronal functions but at the meantime poses a great challenge for neurons to effectively regulate their gene expression. Multiple mechanisms have been adapted by neurons to meet this challenge, such as producing proteins at discreet cellular sites after transporting messenger RNAs with molecular motors. Learning from molecular imaging and analytical experiments, we have identified cellular mechanisms that specifically regulate “time” and “space” of protein synthesis, and output distinct functional consequences. As we become more curious about fine scale of biological time and space, the research tools offered by modern molecular biology becomes more limited…

13:30-14:00 **Atsushi Mochizuki** **(iTHEMS)**

"Controlling cell fate specification system based on network structure"

Abstract: Network structures describing regulation between biomolecules have been determined in many biological systems. Dynamics of molecular activities based on such networks are considered to be the origin of many biological functions. We have recently developed a new theoretical framework (linkage logic theory), with which key nodes for controlling nonlinear dynamics are identified only from network structures without assuming quantitative details, such as functional form, parameter or initial state. Here, we applied this theory to a gene regulatory network for the cell fate specification of seven tissues in the ascidian embryo. We found that this network, which consisted of 92 factors, had only five key molecules. By controlling the activities of these key molecules, the specific gene expression of six out of seven tissues observed in the embryo was successfully reproduced. Since this method is applicable to all nonlinear dynamic systems, we propose this method as a tool for controlling gene regulatory networks and reprogramming cell fates.

[Session 3]

14:00-14:30 **Takashi Okada** **(iTHEMS)**

"Adaptation/plasticity of biochemical reaction systems and network topology"

Abstract: In living cells, large numbers of reactions are connected by sharing substrates or product chemicals, forming complex networks. The dynamics resulting from such complicated networks is not understood sufficiently, mainly because quantitative details on reaction rate functions are still not known. In this talk, I will talk about our recent developments of a theoretical method that determines steady-state behaviors of reaction systems, such as sensitivity and bifurcation behaviors, from network topology alone.

14:00-15:00 **Mineko Kengaku** **(iCeMS)**

"Dynamics and mechanisms of nuclear migration in brain cells"

Abstract: Cell migration events during many developmental and disease processes involve translocation of the large nucleus within the cell. It has been revealed that the nucleus in migrating neurons exhibited dynamic shape changes including elongation, compression, rotation etc., reminiscent of a viscoelastic spherical body drawn in a small caliber fluid chamber. Quantitative measurements of the rheological properties of the nucleus and traction forces exerted on substrates have delineated the force applied to the nucleus during neuronal migration. Microfluidic approach and physical modeling would deepen our understanding of the mechanisms underlying nuclear migration.

[Coffee Break]

[Session 4]

15:30-16:00 **Kaoru Sugimura** **(iCeMS)**

"Quantifying and modelling epithelial morphogenesis"

Abstract: In the course of animal development, the shape of macroscopic tissues emerges from collective cell dynamics. The challenge faced by researchers in the field is to understand the mechanism by which morphogenetic processes of each individual cell (i.e., when, where, and how much individual cells grow, divide, move, and die) collectively lead to the development of a large tissue with its correct shape and size. Answering this question requires a coarse-grained description and modelling of cell and tissue dynamics at an appropriate length scale. In a previous study, we developed coarse-grained measurement methods for stress and kinematic fields. These methods are now emerging as powerful tools used for exploring the mechanics of epithelial tissues. Given the advancement of experimental measurement methods, one can expect that a theoretical model for kinematics and kinetics in a deforming tissue, which can be compared with the experimentally observable fields, will further advance our understanding of the mechanical control of tissue morphogenesis. Here, we present a new continuum model of epithelial mechanics. This model incorporates stress and deformation tensors, which can be compared with experimental data. Using this model, we elucidated dynamical behavior underlying passive relaxation, active contraction-elongation, and tissue shear flow. This study provides an integrated scheme for the understanding of the orchestration of morphogenetic processes in individual cells to achieve epithelial tissue morphogenesis.

16:00-16:30 **Gen Kurosawa** **(iTHEMS)**

"Mathematical study on the mystery of circadian rhythms"

Abstract: Circadian rhythms govern the timing of many physiological events. Mysteriously, the period of the rhythm is stable to temperature although the underlying biochemical reactions usually accelerate with temperature. Using biochemical models, we predicted the possible mechanism for this property, which was verified experimentally by our collaborators.

[Get-together]

18:00-20:00 at **Kyoto Univ. North Campus Cafeteria (COOP)**

Co-hosted by

Institute for Integrated Cell -Material Sciences (iCeMS), Kyoto Univ.

Interdisciplinary Theoretical and Mathematical Sciences (iTHEMS), RIKEN

Kyoto Univ. Institute for Advanced Study (KUIAS), Kyoto Univ.

MACS Program (MACS), Kyoto Univ.

Registration participation (workshop and/or party)

Contact thatsuda@riken.jp
dpackwood@icems.kyoto-u.ac.jp

The agenda of this meeting is empty