CDB SEMINAR

Speaker: **Akatsuki Kimura**

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Title: **"What causes a nucleus to position itself at the cell center?**

-Computer simulations and image processing analyses in C.elegans embryos-"

Date:	**Wednesday, October 5**
Time:	**16:00 -17:00**
Place:	**1F Auditorium of Building C,CDB**

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Summary:

Spatial and temporal dynamics of intracellular structures are critical for cell division and differentiation. A number of mechanistic models underlying the dynamics have been proposed, but there are limited methods to evaluate the feasibility of the models. Our group has been using computer simulations, in combination with image processing analyses, to propose and evaluate mechanistic models on cellular dynamics. We are focusing on microtubule (MT) dependent positioning of centrosomes in one-cell embryos of *C. elegans*, which is important for zygote formation and asymmetric cell division.

After fertilization, in a process called *male pronuclear migration* at prophase, the centrosomes and associated male pronucleus migrate toward the center of the embryo and encounter the female pronucleus. Two mechanistic models were previously proposed for this migration. The pushing model uses the *pushing forces* resulting from MT polymerization, and the pulling model uses the *length-dependent pulling forces* generated by MT motors which are anchored throughout the cytoplasm and pull centrosomes via MTs. Our computer simulation analyses revealed a qualitative and intrinsic difference between the two models. Image processing enabled us to measure the migration *in vivo* and to compare the migration *in vivo* with that in the simulations. Based on the results, we propose that the pulling model contributes primarily to the male pronuclear migration [1]. Later at metaphase, in a process called *posterior spindle displacement*, the centrosomes and associated mitotic spindle migrate away from the center to a posterior position, which results in asymmetric first cell division. This movement is driven by the asymmetric *cortex pulling forces* generated by MT motors which are anchored on the cortex and pull centrosomes. Our analyses predicted novel mechanisms to regulate the onset of posterior spindle displacement, which are supported by the movements of centrosomes before and during metaphase *in vivo*. Based on the results, we have successfully constructed a unified model that explains both male pronuclear migration and posterior spindle displacement. We propose a paradigm of centrosome positioning in animal cells that the positions are determined by a combination of center-directed *length-dependent pulling force* as a basal force and cortex-directed *cortex pulling force* as a regulatory force.

1. Kimura A. and Onami S. (2005) Computer simulations and image processing reveal length-dependent pulling force as the primary mechanism for *C. elegans* male pronuclear migration. *Developmental Cell* **8**, 765-775.

Host: **Hiroki Ueda** **<Systems Biology, CDB>**

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