CDB SEMINAR

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14:00~15:00 Auditorium C1F

Coordinated actomyosin kinetics in generating self-organized pattern formation in the cell cortex

Summary

The cell cortex, which consists of crosslinked actin filaments and non-muscle myosin beneath the cell membrane, is responsible for cell mechanical processes such as deformation and maintenance of cell shape, cytokinesis, and rearrangement of intercellular geometry. These processes are driven by an active contractile stress generated by myosin motor proteins. In the highly contractile cortex, myosin is observed to accumulate in the characteristic aggregate. These myosin foci have finite lifetime, they first form and later disappear. Once formed, they exhibit complex behavior by mechanically interacting each other to move toward or away before disappears. Although a large number of studies have deciphered the molecular components and their regulation for activating actomyosin contractility, the overall dynamical behavior and the coupling between the mechanical and biochemical regulation for this self-organizing behavior has received little attention. We have studied actomyosin foci dynamics in the one cell stage C. elegans embryo. We developed a novel method to characterize turnover kinetics of cortical components in the comoving frame of reference, and have used this method to study, actin, myosin and RHO-1 kinetics. From mass conservation law, temporal change of the components is balanced by advective flux and turnover. Thus we can extract the kinetic change of cortical components by evaluating advective flux. This provides us with the kinetic landscape and the vector field of actomyosin kinetics in the phase space of cortical component concentrations. Interestingly, we observe actomyosin kinetics has a single stable fixed point. There is no biochemical instability in actomyosin kinetics to generate foci dynamics. Instead, foci formation is driven by a coordination between actomyosin mechanochemistry and RHO-1 kinetics. Our results revise our understanding of actomyosin self-organized pattern formation, a structure central to morphogenetic force generation processes.

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