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13:30 - 15:00
Anomalous Diffusion Properties in Biological Transports

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Venue: 2nd floor Seminar Room (#A207)
iCeMS Complex 1, Kyoto University

Subdiffusion, where the mean square displacement (MSD) grows sublinearly with time, has been reported in biological transports, such as two-dimensional diffusion in the plasma membrane and three-dimensional diffusion in the cytoplasm. In particular, mRNA molecules in *E. coli* cells shows subdiffusion in time-averaged MSDs (TAMSDs) obtained from single-molecule tracking experiments. Moreover, the diffusion coefficients are distributed randomly depending on trajectories [1]. These random behaviors could be a manifestation of ergodicity breaking because time averages should converge to a constant if the system is ergodic.

In this presentation, I will talk about anomalous diffusion properties in biological transports. First, I consider the continuous time random walk (CTRW), which is a model of biological diffusion with binding sites. In CTRWs, the TAMSDs exhibit normal diffusion, whereas the MSD exhibits subdiffusion. Moreover, diffusion coefficients in TAMSDs are distributed according to the Mittag-Leffler distribution. In random walks with static disorder (CTRW is a kind of mean field approximations of this model), the distribution of diffusion coefficients is different from the Mittag-Leffler distribution (the modified Mittag-Leffler distribution) if the system is one-dimensional [2]. Next, I will consider an effect of cutoff in trapping-time distributions, which is a result of finite size of binding sites, in CTRWs. This cutoff provides a novel crossover from the distributional behavior to the ordinary ergodic behavior [3].

Finally, using molecular dynamics simulation of a lipid bilayer, I will present that a lipid bilayer is not only viscoelastic but also has a power-law in the trapping-time distribution. Furthermore, I will report that water molecules near the membrane are stickier than those in bulk.

References.
[1] I. Golding and E. C. Cox, Phys. Rev. Lett. **96**, 098102 (2006)
[2] T. Miyaguchi and T. Akimoto, Phys. Rev. E **83**, 031926 (2011)
[3] T. Miyaguchi and T. Akimoto, Phys. Rev. E **83**, 062101 (2011)
[4] T. Akimoto, E. Yamamoto, K. Yasuoka, Y. Hirano and M. Yasui, Phys. Rev. Lett. **107**, 178103 (2011)

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