Title:

Computational studies on the influence of mechanical perturbations due to actions of subnuclear molecules on chromatin organization and dynamics

Presenter:

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Abstract:

Genetic information in a eukaryotic cell is stored in its chromatin, a polymer-like composite of DNA and proteins, densely packed within the nucleus. Physical spacing of chromatin is critical in regulating bio-chemical and transcriptional abilities of genes, and proper functionality of the genomic content depends on the nonrandom organization of chromatin. Meanwhile, in a living cell, other subnuclear molecules, such as enzymes like polymerase and topoisomerase, act to facilitate cellular functions. Mechanical perturbation due to such actions of molecules may affect the chromatin organization and dynamics. In this talk, I would like to explain our computational studies, based on polymer-physics concepts, where we focused on a type of actions of molecules that we call catch-and-release action and implemented in the way inspired by a class of molecules like topoisomerase-II. I will share with the participants the results of our simulations on how it affects chromatin organization and dynamics. The results clarified (i) that the mechanical perturbation of such actions can modulate the phase separation organizations of chromatin called heterochromatic and euchromatic regions [1], and (ii) that the mechanical perturbation enhances fluctuating dynamics of inclusions in chromatin through the newly-proposed dynamic mode of chromatin remodeling [2]. ---
References: [1] R Das, T Sakaue, GV Shivashankar, J Prost, T Hiraiwa (2022) "How enzymatic activity is involved in chromatin organization", eLife 11, e79901; [2] R Das, T Sakaue, GV Shivashankar, J Prost, T Hiraiwa (2024) “Chromatin Remodeling Due to Transient-Link-and-Pass Activity Enhances Subnuclear Dynamics", Physical Review Letters 132, 058401.