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Folding patterns in heterogeneous active polymers

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Abstract:

The folding of various biopolymers, ranging from proteins to chromosomes, into specific conformations is vital for cellular function. Longstanding research has elucidated basic principles of polymer folding with equilibrium thermodynamics. However, thermodynamic constraints such as the fluctuation-dissipation relation can cease to hold in cells, whose organization and regulation involve active processes that provide local excitations. Here, by using analytical theory, we investigate the response of a polymer's conformation to excitations that are heterogeneous in magnitude, correlated along the polymer sequence or, at local hot spots, exhibit temporal patterns that can represent protein (un)binding cycles on chromatin. We characterize how these different types of excitations can lead to specific folding patterns, by eliciting effective long-ranged attraction or repulsion. However, we also find that the folding patterns of an active polymer cannot be distinguished from a passive polymer through structural data, such as contact probability maps, alone. Therefore, in closing, we discuss the different fluctuation properties, such as coherent motion, that can be expected to arise in such systems.

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Time:
9:00 AM-10:15 AM (PT)

About the speaker:

Dr. Andriy Goychuk is a postdoctoral associate at the Massachusetts Institute of Technology, where he will transition to an EMBO Long-Term postdoctoral fellowship in February 2023. He is broadly interested in applying the methods and tools of theoretical biophysics, statistical mechanics and nonlinear dynamics to biological phenomena. Together with Professor Arup K. Chakraborty and Professor Mehran Kardar, he is currently investigating the formation of transcriptional condensates on chromatin and the conformational dynamics of actively driven polymers.

Dr. Goychuk has studied Physics at the Ludwig-Maximilians-University of Munich. Together with Professor Erwin Frey, he investigated different biological systems, ranging from the scale of proteins to the scale of cell dynamics, which have mechanochemical couplings. His thesis was honored with the Arnold Sommerfeld PhD prize.

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