Soft Living Active and Adaptive Matter

CCBM
NSF-CREST
CENTER FOR CELLULAR AND BIOMOLECULAR MACHINES

Thermodynamic control of organization and self-assembly of cytoskeletal networks far away from equilibrium

Yuqing Qiu
The University of Chicago

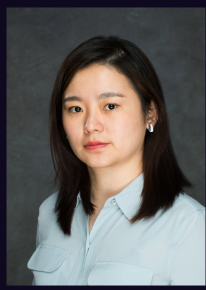
Abstract:

Nonequilibrium self-organization allows the generation of structures that are inaccessible in equilibrium self-assembly. Understanding the role of nonequilibrium driving in self-organization is crucial for developing a predictive description of biological systems, yet it is impeded by their complexity. The actin cytoskeleton serves as a paradigm for how nonequilibrium forces give rise to self-organization. In this talk, I will focus on investigating the interplay of energy dissipation, force generation, and emergent architectures in cytoskeletal networks using non-equilibrium statistical mechanics and computational simulations. In particular, I will discuss how non-equilibrium driving forces due to actin polymerization and activities of molecular motors can be thermodynamically related to the emergent structures of cytoskeletal networks. We are able to identify a unique control principle governing the adaptable formation of non-equilibrium structures in actomyosin networks from a thermodynamic perspective. This work elucidates the relationship between energy dissipation, effective interactions, and pattern formation in active biopolymer networks, and may open an avenue to synthesize bio-inspired active adaptive materials.

Date:
11/21/2022

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

About the speaker:



Yuqing is currently a Yen Postdoctoral Scholar at the James Frack Institute at the University of Chicago, working under the supervision of Prof. Suri Vaikuntanathan and Prof. Aaron Dinner. Her research interests lie in using tools of equilibrium and non-equilibrium statistical mechanics and deploying computational simulations and machine learning models to study the emergent behavior of complex systems in soft matter and materials.

Before moving to the United States for graduate school, she completed her undergraduate studies in chemistry at Zhejiang University in China. She then pursued doctoral research in chemistry under the direction of Prof. Valeria Molinero at the University of Utah with the thesis "Morphologies, Interfacial Properties and Crystallization of Water and Organics in Model Atmospheric Aerosols", for which she won the Cheves T. Walling Award for Ph.D. dissertation. In this work, she used molecular dynamics simulations and developed frameworks based on Classical Nucleation Theory to elucidate the characteristics of organic and biological surfaces that promote the heterogeneous nucleation of ice. During her postdoctoral appointment, she focused on identifying the control laws behind the non-equilibrium self-assembly of cytoskeletal networks from a thermodynamic perspective.

For more information, contact: Kinjal Dasbiswas, Jane BDM Garcia
kdasbiswas@ucmerced.edu, jgarci99@jhu.edu
Sign up at physics.ucmerced.edu/slaam/ to be included in the mailing list to receive a Zoom link.

UNIVERSITY OF CALIFORNIA MERCED PHYSICS