Penn Engineering
University of Pennsylvania
Chemical and Biomolecular Engineering

Fall 2023 Seminar Series

MICHAEL MURRELL

"Energetic Constraints on Biological Assembly and Motion"

Wednesday
October 18, 2023
3:30 PM
Wu and Chen Auditorium
Levine Hall

Associate Professor
Biomedical Engineering
Yale University

ABSTRACT

On small length-scales, the mechanics of soft materials may be dominated by their interfacial properties as opposed to their bulk properties. These effects are described by equilibrium models of elasto-capillarity and wetting. In these models, interfacial energies and bulk material properties are held constant. However, in biological materials, including living cells and tissues, these properties are not constant, but are 'actively' regulated and driven far from thermodynamic equilibrium. As a result, the constraints on work produced during the various physical behaviors of the cell are unknown. Here, by measurement of elasto-capillary effects during cell adhesion, growth and motion, we demonstrate that interfacial and bulk parameters violate equilibrium constraints and exhibit anomalous effects, which depend upon a distance from equilibrium. However, their anomalous properties are reciprocal, and thus in combination reliably define energetic constraints on the production of work arbitrarily far from equilibrium. These results provide basic principles that govern biological assembly and behavior.

BIO

Michael Murrell currently holds the position of an Associate Professor in the Physics and Biomedical Engineering Departments at Yale University. He is part of the Systems Biology Institute and oversees the operations of the Laboratory of Living Matter. Within this laboratory, the focus lies in examining how the non-equilibrium characteristics of biological materials contribute to their biological functions and drive the creation of active materials.

Dr. Murrell obtained his PhD from MIT. Following that, he pursued a collaborative postdoctoral experience, funded by a fellowship from the NSF Institute of Complex Adaptive Matter, which took place jointly at the University of Chicago and the Institut Curie.