Soft Living Active and Adaptive Matter

Active mechanics of sea star oocytes

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Abstract:

The cytoskeleton has the remarkable ability to self-organize into active materials which underlie diverse cellular processes ranging from motility to cell division. Actomyosin is a canonical example of an active material, which generates cellular-scale contractility in part through the forces exerted by myosin motors on actin filaments. While the molecular players underlying actomyosin contractility have been well characterized, how cellular-scale deformation in disordered actomyosin networks emerges from filament-scale interactions is not well understood. In this talk, I'll present work done in collaboration with Sebastian Fürthauer and Nikta Fakhri addressing this question in vivo using the meiotic surface contraction wave seen in oocytes of the bat star Patiria miniata as a model system. By perturbing actin polymerization, we find that the cellular deformation rate is a nonmonotonic function of cortical actin density peaked near the wild type density. To understand this, we develop an active fluid model coarse-grained from filament-scale interactions and find quantitative agreement with the measured data. The model makes further predictions, including the surprising prediction that deformation rate decreases with increasing motor concentration. We test these predictions through protein overexpression and find quantitative agreement. Taken together, this work is an important step for bridging the molecular and cellular length scales for cytoskeletal networks in vivo.

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Time:
9:00 AM-10:15 AM (PT)
12:00 PM-1:15 PM (ET)

About the speaker:

Dr. Peter Foster is a Research Scientist in the Department of Physics at Brandeis University. His research focuses on active cytoskeletal materials. Prior to his current appointment, he was a Physics of Living Systems Fellow at MIT. He received a PhD from Harvard University in Applied Physics working with Prof. Dan Needleman. In January 2023, he will start his group in the Department of Physics and Astronomy at USC.

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