BIOPHYSICS COLLOQUIUM

September 18, 2019 700 Clark Hall, 4pm

Patrick Oakes

Cellular Biophysics
University of Rochester

The Force of the Actin Cytoskeleton: How Polymerization Mediates Stiffness Sensing

The ability of adherent cells to sense changes in the mechanical properties of their extracellular environments is critical to numerous aspects of their physiology. It has been well documented that cell attachment and spreading are sensitive to substrate stiffness. The mechanisms behind this behavior, however, remain unknown. By using spread area as a read out for substrate stiffness sensing, we can explore how cells interpret this mechanical information. Surprisingly, we find that cells are able to respond to changes in substrate stiffness in a myosin (the main force generator in cells) independent manner. Instead, stiffness sensing emerges as the result of the network behavior of adhesion bonds being formed. Specifically, these bonds act as catch-bonds whose lifetime is modulated by forces generated via polymerization of filaments in the cytoskeleton. Using a computational model, we show that on soft substrates these polymerization forces cause the substrate to stretch before the integrin, resulting in a low lifetime. On stiff substrates, the integrin stretches before the substrate, resulting in a long bond lifetime. By increasing the lifetime of integrins on soft substrates, both in our experiments and the model, we can thus get cells to spread as if they were on more rigid substrates. These findings thus have large implications in how we think about the process of mechanotransduction and whether other stiffness sensitive process can be similarly modulated.

Host: Mingming Wu

Biophysics Colloquium chair: Michelle Wang

Biophysics Colloquia website: http://www.biophysics.cornell.edu/seminars