Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Tunable deformation modes shape contractility in active biopolymer networks SAMANTHA STAM, SHILADITYA BANERJEE, KIM WEIRICH, SIMON FREEDMAN, AARON DINNER, MARGARET GARDEL, University of Chicago — Biological polymer-based materials remodel under active, molecular motor-driven forces to perform diverse physiological roles, such as force transmission and spatial self-organization. Critical to understanding these biomaterials is elucidating the role of microscopic polymer deformations, such as stretching, bending, buckling, and relative sliding, on material remodeling. Here, we report that the shape of motor-driven deformations can be used to identify microscopic deformation modes and determine how they propagate to longer length scales. In cross-linked actin networks with sufficiently low densities of the motor protein myosin II, microscopic network deformations are predominantly uniaxial, or dominated by sliding. However, longer-wavelength modes are mostly biaxial, or dominated by bending and buckling, indicating that deformations with uniaxial shapes do not propagate across length scales significantly larger than that of individual polymers. As the density of myosin II is increased, biaxial modes dominate on all length scales we examine due to buildup of sufficient stress to produce smaller-wavelength buckling. In contrast, when we construct networks from unipolar, rigid actin bundles, we observe uniaxial, sliding-based contractions on 1 to 100 μm length scales. Our results demonstrate the biopolymer mechanics can be used to tune deformation modes which, in turn, control shape changes in active materials.

Samantha Stam
University of Chicago

Date submitted: 11 Nov 2016 Electronic form version 1.4