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Effects of motor-induced stresses and pre-stress on the elasticity of semiflexible cytoskeletal networks WILLIAM KLUG, ANDREW MISSEL, MO BAI, ALEX LEVINE, UCLA — The control of the elasticity of cytoskeletal networks appears to rely on the combination of a nonequilibrium state of internal stress generated by molecular motors and the inherently nonlinear stress strain response of the constituent filaments. F-actin is strongly strain hardening under tension so that tensile stresses applied by myosin motors can stiffen the network dramatically. Experiments by Mizuno, Schmidt, and collaborators have shown that the action of these molecular motors can generate hundred-fold increases in the network's modulus. In this talk we present the results of new theoretical and numerical investigations of this phenomenon. Using a newly-developed coarse-grained elastic model of the individual filaments that incorporates a linear bending and a nonlinear stretching response consistent with wormlike chain behavior, we examine the effect of the action of myosin-like molecular motors on the material's elastic constants. The motors generate internal loads due to the application of contractile force pairs to adjacent filaments. Using this model we quantitatively explore the dependence of the nonequilibrium stiffening of the network as a function of the density of active motors. Moreover, we study the effect of quenched pre-stresses on network elastic response.

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