MAR08-2007-003885

Abstract for an Invited Paper
for the MAR08 Meeting of
the American Physical Society

Non-equilibrium mechanics and dynamics of active gels and living cells

FRED MACKINTOSH, Vrije Universiteit

Much like the bones in our bodies, the *cytoskeleton* consisting of filamentous proteins largely determines the mechanical response and stability of cells. Such important cellular processes as locomotion, cell division, and mechanosensing are largely governed by complex networks of cytoskeletal biopolymers and associated proteins that cross-link these and/or generate forces within the network. In addition to their important role in cell mechanics, cytoskeletal biopolymers have also provided new insights and challenges for polymer physics and rheology. In the cell, however, these polymer networks or gels are far from equilibrium in a way unique to biology: they are subject to active internal force generation by molecular motors. We describe recent theoretical and experimental results on active in vitro networks that demonstrate significant stiffening and non-equilibrium fluctuations due to motor activity [1]. We show how this activity leads generically to a colored, $1/\omega^2$ spectrum of force fluctuations, which can account for surprisingly Brownian-like motion in elastic networks. We also discuss how the fluctuations of individual cytoskeletal filaments can be used to probe both mechanical properties and non-equilibrium activity in living cells [2].

[1] D Mizuno, C Tardin, CF Schmidt, FC MacKintosh, *Science*, 315:370 (2007).
[2] CP Brangwynne, FC MacKintosh, DA Weitz, *PNAS*, 104:16128 (2007).