Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Active contractility and motor-driven effective interactions in a model cytoskeleton[1] SHENSHEN WANG, Massachusetts Institute of Technology, PETER WOLYNES, Rice University — Contractile forces are essential for many developmental processes involving cell shape change and tissue deformation. Recent experiments on reconstituted actomyosin network, the major component of the contractile machinery, have shown that active contractility occurs above a threshold motor concentration and within a window of cross-link concentration. We present a microscopic dynamic model that incorporates two essential aspects of actomyosin self-organization: the asymmetric load response of individual actin filaments and the correlated motor-driven events mimicking myosin-induced filament sliding. Using computer simulations, we examine how the concentration and susceptibility of motors contribute to their collective behavior and interplay with the network connectivity to regulate macroscopic contractility. Our model is shown to capture the formation and dynamics of contractile structures and agree with the observed dependence of active contractility on microscopic parameters. We further provide a theoretical framework to investigate the intricate interplay between local force generation, network connectivity and collective action of molecular motors. This framework is capable of accommodating both regular and heterogeneous pattern formation, arrested coarsening and macroscopic contraction in a unified manner.

[1]This work is supported by NSF via Grant PHY-0822283 and the Bullard-Welch Chair at Rice University.

Shenshen Wang
Massachusetts Institute of Technology

Date submitted: 09 Nov 2012 Electronic form version 1.4