Abstract Submitted
for the MAR11 Meeting of
The American Physical Society

The Interplay of Nonlinearity and Architecture and Nonequilibrium Dynamics in Cytoskeletal Mechanics SHENSHEN WANG, Dept of Physics, UCSD, TONGYE SHEN, Dept of Biochemistry, Cellular and Molecular Biology, Univ. of Tennessee, PETER WOLYNES, Dept of Physics, Dept of Chemistry and Biochemistry, UCSD — The interplay between cytoskeletal architecture and the nonlinearity of the interactions due to bucklable filaments plays a key role in modulating the cell's mechanical stability and its structural rearrangements. We first study a model of cytoskeletal structure treating it as an amorphous network of hard centers rigidly cross-linked by nonlinear elastic strings, neglecting the effects of motorization. Using simulations along with a self-consistent phonon method, we show that this minimal model exhibits diverse thermodynamically stable mechanical phases that depend on excluded volume, crosslink concentration, filament length and stiffness. Within the framework set by the free energy functional formulation and making use of the random first order transition theory of structural glasses, we further estimate the characteristic densities for a kinetic glass transition to occur in this model system. Network connectivity strongly modulates the transition boundaries between various equilibrium phases, as well as the kinetic glass transition density. We further study the effects of motorization and polymerization upon the stability and dynamics of this model system.

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Date submitted: 18 Nov 2010 Electronic form version 1.4