Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Stochastic model of profilin-actin polymerization BRANDON HORAN, DIMITRIOS VAVYLONIS, Lehigh University — A driving factor in cell motility and other processes that involve changes of cell shape is the rapid polymerization of actin subunits into long filaments. This process is regulated by profilin, a protein which binds to actin subunits and regulates elongation of actin filaments. Whether profilin stimulates polymerization by coupling to hydrolysis of ATP-bound actin is debated. Previous studies have proposed indirect coupling to ATP hydrolysis using rate equations, but did not include the effects of fluctuations that are important near the critical concentration. We developed stochastic simulations using the Gillespie algorithm to study single filament elongation at the barbed end in the presence of profilin. We used recently measured rate constants and estimated the rate of profilin binding to the barbed end such that detailed balance is satisfied. Fast phosphate release at the tip of the filament was accounted for. The elongation rate and length diffusivity as functions of profilin and actin concentration were calculated and used to extract the critical concentrations of free actin and of total actin. We show under what conditions profilin leads to an increase in the critical concentration of total actin but a decrease in the critical concentration of free actin.

Brandon Horan
Lehigh University

Date submitted: 24 Nov 2015 Electronic form version 1.4