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Whole Cell Model of Actin Diffusion and Reaction based on Single Molecule Speckle Microscopy Measurements LAURA MCMILLEN, DIMITRIOS VAVYLONIS, Lehigh University, VAVYLONIS GROUP TEAM — It is debated whether transport of actin across the cell by diffusion alone is sufficiently fast to account for the rapid reorganization of actin filaments at the leading edge of motile cells. In order to investigate this question, we created a 3D model of the whole cell that includes reaction and diffusion of actin using a particle Monte Carlo method. For the lamellipodium of the simulated cell we use the model by Smith et al. Biophys. J 104:247 (2013), which includes two diffuse pools of actin, one which is slowly diffusing and the other which diffuses more quickly, as well as a pool of filamentous actin undergoing retrograde flow towards the cell center. We adjusted this model to fit a circular geometry around the whole cell. We also consider actin in the cell center which is either diffusing or in stationary filamentous form, representing cortical actin or actin in stress fibers. The local rates of polymerization and the lifetime distributions of polymerized actin were estimated from single molecule speckle microscopy experiments by the group of N. Watanabe. With this model we are able to simulate prior experiments that monitored the redistribution of actin after photoactivation or fluorescence recovery after photobleaching in various parts of the cell. We find that transport by diffusion is sufficient to fit these data, without the need for an active transport mechanism, however significant concentration gradients may develop at steady state.

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