Stochastic Dynamics of Dorsal Actin Waves on Fibroblasts

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Albeit waves of polymerizing actin are a fundamental element of the motility apparatus of cells, the machinery of Dorsal Actin Waves (DAWs) [1] is poorly understood. In search of the mechanisms organizing DAWs we analyze experimental data of the dynamics of DAWs under well-defined experimental conditions. We find that DAWs show all characteristic features of waves in active media, e.g. oscillatory states, collision annihilation, and spirals. DAWs can be constrained to propagate along a quasi one-dimensional path with periodic boundary conditions via micro-contact printing. Under these conditions DAWs form pronounced and extremely regular, but stochastic spatio-temporal patterns. We use microfluidics to control the biochemical state of cells, which permits us to reversibly switch between different states of actin depolymerization using Latrunculin A. The periods between successive wave events and the propagation velocities of DAWs serve as readouts DAW dynamics in the parameter space of actin depolymerization rate and free actin monomers. We find that the propagation velocity of DAWs can be reduced by a factor of two by increasing depolymerization rates of actin, whereas the periods between successive wave events double. This clearly shows that the wave machinery of DAWs is regulated close to actin itself and not controlled by RhoGTPases.

[1] E. Bernitt, C.-G. Koh, N. S. Gov, H.-G. Döbereiner, *Dynamics of Actin Waves on Patterned Substrates: A Quantitative Analysis of Circular Dorsal Ruffles*, PLoS ONE 10, e0115857 (2015).