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The actin cytoskeleton of chemotactic amoebae operates close to the onset of oscillations[1] CHRISTIAN WESTENDORF, JOSE NEGRETE JR., MPI Dynamics and Self-Organization, Goettingen, Germany., ALBERT BAE, Department of physics, University of California, San Diego, CA, USA., RABEA SANDMANN, EBERHARD BODENSCHATZ, MPI Dynamics and Self-Organization, Goettingen, Germany., CARSTEN BETA, Institute of Physics and Astronomy, University of Potsdam, Germany. — We report evidence that the actin machinery of chemotactic Dictyostelium cells operates close to an oscillatory instability. The averaged F-actin response of many cells to a short-time pulse of cAMP is reminiscent of a damped oscillation. At the single-cell level, however, the response dynamics ranged from short, strongly damped responses to slowly decaying, weakly damped oscillations. Furthermore, in a small subpopulation, we observed self-sustained oscillations in the cortical F-actin concentration. We systematically exposed a large number of cells to periodic pulse trains. The results indicate a resonance peak at periodic inputs of around 20 s. We propose a delayed feedback model that explains our experimental findings based on a time-delay in the actin regulatory network. To quantitatively test the model, we performed stimulation experiments with cells that express GFP-tagged fusion proteins of Coronin and Aip1. These served as markers of the F-actin disassembly process and thus allow us to estimate the delay time. Based on this independent estimate, our model predicts an intrinsic period of 20 s, which agrees with the resonance observed experimentally.

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