Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Flow-driven waves during pattern formation of Dictyostelium discoideum AZAM GHOLAMI, Max Planck Institut for Dynamics and Self-Organization, Goettingen, Germany, OLIVER STEINBOCK, Department of Chemistry and Biochemistry, Florida State University, Tallahassee, Florida, VLADIMIR ZYKOV, Max Planck Institute for Dynamics and Self-Organization, Goettingen,Germany, EBERHARD BODENSCHATZ, Max Planck Institut for Dynamics and Self-Organization, Goettingen, Germany — The slime mold Dictyostelium discoideum (D.d.) is a well known model system for the study of biological pattern formation. In the natural environment, aggregating populations of starving Dictyostelium cells may experience fluid flows that can profoundly change the underlying wave generation process. Recently we conducted experiments to study the effect of a differential flow in quasi one-dimensional colonies of the signaling D.d. cells. The external flow advects the signaling molecule cAMP downstream, while the chemotactic cells attached to the solid substrate and are not transported with flow. This transport anisotropy in the extracellular medium induced macroscopic wave trains that developed spontaneously, propagated with the velocity proportinoal to the imposed flow velocity with a unique period. In this work, we investigate the mechanism of flow-induced waves using the well-established Martiel-Goldbeter model. In the linear regime, our analytical calculations show that a convective transport of extracellular cAMP in a uniform field of signal-relaying cells leads to a flow-induced instability of the traveling-wave type. In the nonlinear regime, numerical simulations show a convective instability with propagating waves, in agreement with the predictions of linear analysis.

Azam Gholami
Max Planck Institute for Dynamics and Self-Organization, Goettingen

Date submitted: 13 Nov 2014 Electronic form version 1.4