Establishing direction during chemotaxis in eukaryotic cells

Wouter-Jan Rappel(1) **;, Peter J. Thomas**(2)**, Herbert Levine**(1) **and William F. Loomis**(3)

(1) Department of Physics, University of California, San Diego. La Jolla, CA 92093-0319
(2) Computational Neurobiology Laboratory, Salk Institute for Biological Studies, San Diego, CA 92186-5800
(3) Division of Biology, University of California, San Diego, La Jolla, CA 92093-0368

Presenting author. Wouter-Jan Rappel, E-mail: rappel@physics.ucsd.edu

Abstract
Amoeboid cells of *Dictyostelium discoideum* respond to the chemoattractant cAMP by rapid translocation of PH-domain proteins to the cell membrane where these proteins participate in the modulation of the cytoskeleton and relay of the signal. In a natural field of aggregation competent cells, in which pulses of cAMP are released periodically, and in experiments where cAMP is released from a pipette the localization is found predominantly on the proximal side (the front). We propose a simple mechanism in which a second messenger, generated by local activation of the membrane, diffuses through the interior of the cell, suppresses the activation of the back of the cell and converts the temporal gradient into an initial cellular asymmetry. This asymmetry may be critical for dispersed cells in shallow gradients to establish long lasting polarity in spatial gradients. The plausibility of the inhibitory mechanism is demonstrated via numerical simulations and its sensitivity to fluctuations in model parameters is determined. We propose dual stimulus experiments that can discriminate between the mechanism in our model and more exotic possibilities. Available evidence suggests that the internal inhibitor may be cGMP which accumulates within less than a second following treatment of cells with external cAMP.