

MAR06-2006-040172

Abstract for an Invited Paper  
for the MAR06 Meeting of  
the American Physical Society

**Dictyostelium discoideum chemotaxis: threshold for directed motion**

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The chemotactic response of *Dictyostelium discoideum* cells to stationary, linear gradients of cyclic adenosine 3',5'-monophosphate (cAMP) was studied using microfluidic devices. In shallow gradients of less than  $10^{-3}$  nM/ $\mu$ m, the cells showed no directional response and exhibited a constant basal motility. In steeper gradients, cells moved up the gradient on average. The chemotactic speed and the motility increased with increasing steepness up to a plateau at around  $10^{-1}$  nM/ $\mu$ m. In very steep gradients, above 10 nM/ $\mu$ m, the cells lost directionality and the motility returned to the sub-threshold level. In the regime of optimal response the difference in receptor occupancy at the front and back of the cell is estimated to be only about 100 molecules. The work is supported by the Biocomplexity Program of the NSF and the Max Planck Society.