Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

**Responding to flow: How phytoplankton adapt migration strategies to tackle turbulence** ANUPAM SENGUPTA, FRANCESCO CARRARA, ROMAN STOCKER, Massachusetts Institute of Technology — Phytoplankton are among the ocean's most important organisms and it has long been recognized that turbulence is a primary determinant of their fitness. Yet, mechanisms by which phytoplankton may adapt to turbulence have remained unknown. We present experiments that demonstrate how phytoplankton are capable of rapid adaptive behavior in response to fluid flow disturbances that mimic turbulence. Our study organism was the toxic marine alga *Heterosigma akashiwo*, known to exhibit "negative gravitaxis," *i.e.*, to frequently migrate upwards against gravity. To mimic the effect of Kolmogorov-scale turbulent eddies, which expose cells to repeated reorientations, we observed *H. akashiwo* in a "flip chamber," whose orientation was periodically flipped. Tracking of single cells revealed a striking, robust behavioral adaptation, whereby within tens of minutes half of the population reversed its direction of migration to swim downwards, demonstrating an active response to fluid flow. Using confocal microscopy, we provide a physiological rationalization of this behavior in terms of the redistribution of internal organelles, and speculate on the motives for this bet-hedging-type strategy. This work suggests that the effects of fluid flow – not just passive but also active – on plankton represents a rich area of investigation with considerable implications for some of earth's most important organisms.

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Date submitted: 29 Jul 2014 Electronic form version 1.4