Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

Stirring by squirmers[1] JEAN-LUC THIFFEAULT, University of Wisconsin, ZHI LIN, IMA, University of Minnesota, STEPHEN CHILDRESS, Courant Institute, NYU — We analyse a simple "Stokesian squirmer" model for the enhanced mixing due to swimming micro-organisms [1]. The model is based on a calculation of Thiffeault & Childress [2], where fluid particle displacements due to inviscid swimmers are added to produce an effective diffusivity. Here we show that for the viscous case the swimmers cannot be assumed to swim an infinite distance, even though their total mass displacement is finite. Instead, the largest contributions to particle displacement, and hence to mixing, arise from random changes of direction of swimming and are dominated by the far-field stresslet term in our simple model. We validate the results by numerical simulation. We also calculate nonzero Reynolds number corrections to the effective diffusivity. Finally, we show that displacements due to randomly-swimming squirmers exhibit PDFs with exponential tails and a short-time superdiffusive regime, as found previously [3]. In our case, the exponential tails are due to "sticking" near the stagnation points on the squirmer's surface.

[1] Lin, Z., Thiffeault, J.-L. & Childress, S., arxiv.org/abs/1007.1740
[2] Thiffeault, J.-L. & Childress, S., *Phys. Lett. A* **374**, 3487 (2010).
[3] Leptos, K. C., Guasto, J. S., Gollub, J. P., Pesci, A. I. & Goldstein, R. E. *Phys. Rev. Lett.* **103**, 198103 (2009).

[1]Supported by NSF.

Jean-Luc Thiffeault
University of Wisconsin

Date submitted: 27 Jul 2010 Electronic form version 1.4