Abstract Submitted
for the SES08 Meeting of
The American Physical Society

Directed Fluid Transport with Biomimetic "Silia" Arrays A.R. SHIELDS, B.A. EVANS, B.L. CARSTENS, M.R. FALVO, S. WASHBURN, R. SUPERFINE, Dept. of Physics - UNC - Chapel Hill — We present results on the long-range, directed fluid transport produced by the collective beating of arrays of biomimetic "silia." Silia are arrays of free-standing nanorods roughly the size of biological cilia, which we fabricate from a polymer-magnetic nanoparticle composite material. With external permanent magnets we actuate our silia such that their motion mimics the beating of biological cilia. Biological cilia have evolved to produce microscale fluid transport and are increasingly being recognized as critical components in a wide range of biological systems. However, despite much effort cilia generated fluid flows remain an area of active study. In the last decade, cilia-driven fluid flow in the embryonic node of vertebrates has been implicated as the initial left-right symmetry breaking event in these embryos. With silia we generate directional fluid transport by mimicking the tilted conical beating of these nodal cilia and seek to answer open questions about the nature of particle advection in such a system. By seeding fluorescent microparticles into the fluid we have noted the existence of two distinct flow regimes. The fluid flow is directional and coherent above the tips of the silia, while between the silia tips and floor particle motion is complicated and suggestive of chaotic advection.

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Date submitted: 15 Aug 2008 Electronic form version 1.4