Abstract Submitted
for the MAR10 Meeting of
The American Physical Society

Hydrodynamic Synchronization in a Multiple-Paddle Model System[1] BIAN QIAN, DAVID GAGNON, Brown University, HONGYUAN JIANG, Johns Hopkins University, THOMAS POWERS, KENNETH BREUER, Brown University — Hydrodynamic synchronization is important in many biological systems such as beating cilia and cell motility. Here we study a model problem, in which flexible paddles rotate in a viscous liquid. We examine a three-paddle system and show that, depending on the arrangement, paddles can exhibit either a periodic phase difference variation or converge to a synchronization state. The phase difference in the synchronized state is determined not only by the symmetry of the paddle but also by the paddles' relative position. Measurement of paddles' rotational speeds shows that the drag between paddles is minimized during synchronization. Theoretical approaches developed for two-paddle systems are extended to the current geometries, and numerical simulations, using the method of regularized stokeslets, are also used to explore the dynamics of multiple paddle systems.

[1]Supported by NSF

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Date submitted: 22 Dec 2009 Electronic form version 1.4