Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Hydrodynamic synchronization of flagella on the surface of the colonial alga *Volvox carteri* DOUGLAS BRUMLEY, MARCO POLIN, RAYMOND GOLDSTEIN, TIMOTHY PEDLEY, DAMTP, University of Cambridge —
Whether on the surface of unicellular ciliates or in the respiratory epithelium, groups of eukaryotic cilia and flagella are capable of coordinating their beating over large scales. The mechanism responsible for the emergence of these metachronal waves is still unclear, mostly because finding an experimental system in which the beating filaments can be followed individually is challenging. We propose the multicellular green alga *Volvox carteri* as an ideal model system to study metachronal coordination, and report the existence of robust metachronal waves on its surface. Inspired by flagellar tip trajectories of *Volvox* somatic cells, we model a flagellum using a sphere of radius a elastically bound to a circular orbit of radius r_0, perpendicular to a no-slip plane. This elastohydrodynamic model of weakly-coupled self-sustained oscillators can be recast in terms of interacting phase oscillators, offering an intuitive understanding of the mechanism driving the emergence of coordination. Our results confirm that elasticity is fundamental to guarantee fast and robust synchronization, and that sufficiently compliant trajectories lead to the emergence of metachronal waves in a manner essentially independent of boundary conditions.

Douglas Brumley
DAMTP, University of Cambridge

Date submitted: 02 Aug 2012 Electronic form version 1.4