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FLUID MECHANICS OF SWIMMING MICROORGANISMS IN COMPLEX FLUIDS

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ABSTRACT:

Swimming microorganisms are typically found in complex fluids, which are full of polymers. We use theory and simple scale-model experiments to study how viscoelasticity affects the swimming speed of swimmers with simple illustrative stroke patterns, such as small-amplitude traveling waves and rigid-body rotation of helices. We also study swimming mechanics in anisotropic media, using a hexatic liquid crystal as a model.

We find that the nature of anchoring conditions for the liquid-crystalline degrees of freedom plays a critical role in determining the swimming speed. Furthermore, we study the fluid transport induced by the swimmers motion by calculating the flux of fluid in the laboratory frame.

BIOGRAPHY:

Tom Powers received an S.B. in Physics and an S.B. in mathematics from the Massachusetts Institute of Technology in 1989. In 1995, he received his Ph.D. in Physics from the University of Pennsylvania, with Prof. Phil Nelson serving as his advisor. After Penn, he held postdoctoral positions in the physics departments of Princeton University and the University of Arizona with Prof. Ray Goldstein. Then he was a postdoctoral fellow at Harvard University with Howard Stone in the Division of Engineering and Applied Sciences. He joined the Division of Engineering (now School of Engineering) of Brown University in 2000 as the first holder of the James R. Rice Term Chair in Solid Mechanics. He is now Professor of Engineering and Professor of Physics. He serves as an associate editor of Reviews of Modern Physics, and is a fellow of the American Physical Society.