Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

Aquatic bacteria elongate and wobble their bodies for flagellar performance[1] BIN LIU, JOANNA VALENZUELA, POOJA CHOPRA, School of Natural Sciences, UC Merced — Bacteria are endowed with well-regulated sizes and shapes. A bacillus has a rod-like cell body, achieving swimming motility by rotating a single flagellum or multiple flagella. Along with other shapes, this elongated cell is often viewed as a payload, and its movements are regarded as passive responses to its flagellar propulsion. Here, we simultaneously measured the morphology and movement of individual free-swimming bacteria using an automated tracking microscope and 3D reconstruction techniques. These cells were found to consistently precess, based on reconstructions of the apparent wobbling movements viewed from a microscope. Through a hydrodynamic model that incorporates such precessing cell bodies and rod-like geometries, we found that there is a critical cell size below which wobbling movement is beneficial for flagellar performance. This critical cell size is consistent with the cellular morphologies of Caulobacter crescentus and Escherichia coli, as examples of single- and multi-flagellated species that are known for wobbling movements in aquatic environments. We also showed that the moderate cell sizes of these species could be attributed to a compromise between dispersal speed and power consumption.

[1]The authors thank the support of NSF-CREST: Center for Cellular and Biomolecular Machines at UC Merced (NSF-HRD-1547848).

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Date submitted: 29 Jul 2017 Electronic form version 1.4