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Propulsion of helical flagella near boundaries BRUCE RODENBORN, GRANT GIESBRECHT, KATHA NI, ISAAC VOCK, Centre College — The presence of nearby boundaries is known to have dramatic effects on the swimming behavior of microorganisms because of the no-slip condition at the boundary. Microorganisms that use a helical flagellum experience forces both along the axis of the helix and in the direction perpendicular to the axis. These low Reynolds number boundary effects have primarily been studied using live bacteria and using numerical simulations. However, small scale measurements give limited information about the forces and torques on the microorganisms. Furthermore, numerical studies are approximate because they have generally used Stokeslet-based simulations with image Stokeslets to represent the effects of the boundaries. Instead, we directly measure the propulsion of macroscopic helical flagella with diameter $\approx$ 12mm using a fluid with viscosity 10^5 times that of water to ensure the Reynolds number in the experiments is much less than unity, just as for bacteria. We measure the parallel and perpendicular forces as a function of boundary distance to determine the nonzero elements of the propulsive matrix for axial rotation near a boundary. We then compare our results to the theory and simulations of Lauga et al. (Biophys. J. 2006) and to biological measurements.

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