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Hydrodynamic Optimality in the Bacterial Flagellum SAVERIO SPAGNOLIE, Brown University, ERIC LAUGA, University of California, San Diego — Most bacteria swim through fluids by rotating helical flagella which can take one of 12 distinct polymorphic shapes, the most common of which is the normal form used during forward swimming runs. To shed light on the prevalence of the normal form in locomotion, we have gathered all available experimental measurements of the various polymorphic forms and computed their intrinsic hydrodynamic efficiencies. The normal helical form is found to be the most efficient of the 12 polymorphic forms by a significant margin–a conclusion valid for both the peritrichous and polar flagellar families, and robust to a change in the effective flagellum diameter or length. Hence, although energetic costs of locomotion are small for bacteria, fluid mechanical forces may have played a significant role in the evolution of the flagellum.

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