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Rotational dynamics of a towed superhelix in a Stokes fluid KATHLEEN MARECK, SUNGHWAN JUNG, Applied Math Lab, Courant Institute, NYU, LISA FAUCI, Department of Mathematics, Tulane University, MICHAEL SHELLEY, Applied Math Lab, Courant Institute, NYU — Most bacteria use trailing and rotating flagella to locomote through a fluid. The spirochete bacterium instead locomotes itself by rotating its entire super-helically shaped body, driven by a flagellum that is threaded along its body. A natural question is how the effectiveness of locomotion depends on the detailed helix and super-helix arrangement (e.g. different handedness, different pitches). With this motivation, we study the rotational dynamics of super-helical bodies being towed through highly viscous fluids. A typical body is short-pitched helix whose axis is itself shaped as a helix of larger pitch and opposite handedness. We find that the direction and rate of the rotation of the body is a result of competition between these two super-posed helices; For small axial helix amplitude, the body dynamics is controlled by the short-pitched helix, while there is a cross-over at larger amplitude to control by the axial helix. We also investigate this system by numerically constructing solutions to the Stokes equations using the method of regularized Stokeslets and find excellent agreement between our numerical and experimental results.

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