Abstract Submitted
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Slender Ribbon Theory LYNDON KOENS, ERIC LAUGA, Univ of Cambridge — Ribbons are long narrow strips possessing three distinct material length scales (thickness, width, and length) which allow them to produce unique shapes unobtainable by wires or filaments. Significant effort has gone into determining the structural shapes of ribbons but less is know about their behavior in viscous fluids. Here we determine asymptotically the leading-order hydrodynamic behavior of a slender ribbon in Stokes flows. The derivation, reminiscent of slender-body theory for filaments, assumes that the length of the ribbon is much larger than its width, which itself is much larger than its thickness. The final result is an integral equation for the force density on a mathematical surface located inside the ribbon. Our derivation agrees very well with the known hydrodynamics of long flat ellipsoids, and successfully captures the swimming behavior of artificial microscopic swimmers recently explored experimentally. Our asymptotic results provide the fundamental framework necessary to predict the behavior of slender ribbons at low Reynolds numbers in a variety of biological and engineering problems.

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