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Autonomous propulsion of nanorods trapped in an acoustic field

JOHN SADER, JESSE COLLIS, DEBADI CHAKRABORTY, The University of Melbourne — Recent measurements demonstrate that nanorods trapped in acoustic fields generate autonomous propulsion, with their direction and speed controlled by both the particle's shape and density distribution. In this talk, we investigate the physical mechanisms underlying this combined density/shape induced phenomenon by developing a simple yet rigorous mathematical framework for arbitrary axisymmetric particles. This only requires solution of the (linear) unsteady Stokes equations. Geometric and density asymmetries in the particle generate axial jets that can produce motion in either direction. Strikingly, the propulsion direction is found to reverse with increasing frequency, an effect that is yet to be reported experimentally. The general theory and mechanism described here enable the *a priori* design and fabrication of nano-motors in fluid for transport of small-scale payloads and robotic applications.

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