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Advective symmetry breaking in phoretic motion of colloidal particles ADITYA KHAIR, Department of Chemical Engineeering, Carnegie Mellon University — The phoretic motion of a colloidal particle is animated by an imposed gradient of a scalar field: e.g. solute gradients cause diffusiophoresis and temperature gradients drive thermophoresis. It is customarily assumed that the scalar field evolves solely via diffusion (i.e. the Peclet number is zero). This leads to Morrison's remarkable result that the translational phoretic velocity of a colloid is independent of its size, shape, and orientation relative to the imposed gradient (the colloid does not rotate, either). Moreover, colloids comprising a dispersion are predicted to translate with identical velocities. However, intuitively, as a colloid moves it sets up a fluid flow that advects the same scalar field that instigated its motion. Here, using asymptotic analysis, we explore the first effects of advection on the phoretic motion of colloidal particles (i.e. at the experimentally relevant conditions of small but finite Peclet number). We show that advection leads to symmetry breaking in the phoretic motion of fore-aft asymmetric particles, where the particle velocity depends on the direction of the imposed gradient. We demonstrate that advection drives phoretic rotation of nonspherical colloids. Last, advection is shown to cause relative motion between colloidal particles.

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