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Regular and chaotic trajectories of swimmers in two-dimensional, time-independent flows[1] SIMON BERMAN, KEVIN MITCHELL, University of California, Merced — We present a theoretical investigation of the motion of ellipsoidal swimmers in externally imposed, two-dimensional fluid flows. Two canonical flow geometries are considered: a hyperbolic flow and a vortex array. In the hyperbolic flow, all swimmer trajectories are regular, but we find that they are restricted by one-way barriers. These barriers are shown to be swimming invariant manifolds (SwIMs): invariant manifolds of certain fixed points of the swimmer equations of motion. In the vortex array, we find both regular and chaotic trajectories of swimmers, including trajectories that exhibit long-range transport. This stands in stark contrast to passive tracers in the same flow, which move on localized, regular orbits when the flow is time-independent. The SwIMs are shown to form leaky one-way barriers to swimmers, and we identify additional phase-space structures—namely, periodic orbits and invariant tori—which regulate the chaotic transport of swimmers throughout the vortex array.

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