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Upstream swimming of active Brownian particles in pressure-driven flow[1] ZHIWEI PENG, JOHN BRADY, California Institute of Technology — Active Brownian particles (ABPs) accumulate at boundaries that confine them owing to their persistent self-propulsion. In the presence of a pressure-driven flow, the fluid vorticity tends to rotate ABPs toward the upstream direction. As a result, ABPs in pressure-driven flow can exhibit a net upstream motion. In this work, we use continuum theory and Brownian dynamics simulation to study the effects of pressure-driven flow on the dynamics of ABPs. In particular, we quantify the net mean speed of ABPs in a channel, which results from a competition between downstream fluid advection and upstream swimming. We characterize the transition between net upstream and downstream motion as a function of the flow speed, Brownian diffusion and the intrinsic swimming speed of ABPs. Our results show that the interplay between self-propulsion, fluid vorticity and confinement provides a robust mechanism for upstream motility.

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