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Taylor dispersion of active Brownian particles[1] JOHN BRADY, ZHIWEI PENG, California Institute of Technology — Compared to the well-studied Taylor dispersion of passive Brownian particles, an understanding of the dispersion of active Brownian particles (ABPs) in a pressure-driven flow is less developed. From a small wavenumber expansion of the Smoluchowski equation for the particle distribution, we explicitly derive an effective advection-diffusion equation for the cross-sectional average of the particle number density. We characterize the effective longitudinal dispersivity of ABPs in relation to the flow speed, the intrinsic swimming speed of the ABPs and their Brownian diffusion. In particular, the dispersion of ABPs includes the classical shear-enhanced (Taylor) dispersion and an active contribution called the swim diffusivity. While pressure-driven flow always enhances particle diffusion through the classical Taylor dispersion process, it can either enhance or hinder the swim diffusivity. As a result, the dispersivity of ABPs exhibits a non-monotonic variation as a function of the flow speed. Our continuum theory is corroborated by a direct Brownian dynamics simulation of the Langevin equations governing the motion of each ABP.

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Zhiwei Peng
California Institute of Technology

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