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Shear-enhanced diffusion in colloidal suspensions IAN GRIFFITHS, University of Oxford, HOWARD STONE, Princeton University — The familiar example of Taylor dispersion of molecular solutes is extended to describe the dispersion in a colloidal suspension. In almost all standard Taylor-dispersion analysis, thermal fluctuations (Brownian motion) are assumed to be the underlying stochastic element driving solutes across streamlines. Here we consider conditions relevant to colloid suspensions, where shear-enhanced diffusion, which is a consequence of hydrodynamic interactions between particles, and is dependent on the concentration of particles, is responsible for the fluctuations transverse to the flow direction. The generic scheme is illustrated by the example of axisymmetric Poiseuille pipe flow, with a simple functional form for the diffusivity that captures both the shear-induced and Brownian contributions. This description naturally leads to a nonlinear convection-diffusion equation, which we solve analytically for a simplified model valid for low particle concentrations, and numerically for a model of higher concentrations, and the results are contrasted with regular Taylor dispersion. The approach presented here may be useful for a range of problems involving transport properties of colloidal suspensions, such as sedimentation and membrane filtration.

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