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Force-induced diffusion in hydrodynamically interacting colloidal dispersions: non-monotonic connections between fluctuation and dissipation NICHOLAS HOH, ROSEANNA ZIA, Cornell University — Effects of hydrodynamic interactions on equilibrium self-diffusivity are well known; here we explore their influence on the force-induced diffusion of a microrheological probe by tuning the strength of such interactions via an excluded-annulus model. As the probe is driven through the suspension, its force-induced diffusion (microdiffusivity) is determined analytically in the limits of strong and weak forcing, and numerically for all forcing. The total diffusivity comprises that of an isolated probe, the entropic hindrance of the equilibrium microstructure, and non-equilibrium interactions between probe and bath particles. When hydrodynamic interactions are important, three factors contribute to the microdiffusivity: a reduction in probe mobility; Brownian flux due to microstructural deformation; and entropic exclusion (collisions). Long-range hydrodynamic interactions diminish all components of the microdiffusivity; however, lubrication interactions enhance longitudinal encounters. This manifests as a monotonic increase with flow strength, but with a surprising non-monotonic dependence on the strength of hydrodynamic interactions. That is, the role of hydrodynamics in the connection between diffusive fluctuation and viscous dissipation is non-monotonic.

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