Inertial effects in Brownian motion of a trapped particle in shear flow

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Abstract:

The Brownian motion of a bound particle in shear flow is a basic problem in colloid and polymer science. Since the flow has a rotational component, the description cannot be cast in the usual equilibrium statistical mechanics framework of particle motion in a potential well. Instead, the property of local equilibrium may be exploited which necessitates the inclusion of the particle's inertia. Accordingly, a fluctuation dissipation relation is derived which contains a correction due to the interplay between particle inertia and shear flow. The result shows that at very high shear rates, local equilibrium cannot prevail. Having established the relation between drift and diffusion matrices the full stochastic description of the particle dynamics in phase space is obtained from the Langevin equation. Possibilities to measure the predicted inertia effects and implications for computer simulations of complex fluids in shear flows are discussed.

Keywords: Brownian motion; Colloids; Polymers; Shear flow; Trapped particles; Computer simulation

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