253f Hydrodynamic and Brownian Fluctuations in Colloidal Suspensions

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We adapt stochastic rotation dynamics, a mesoscopic computer simulation method, to colloidal suspensions, making sure length and time-scales are carefully separated to generate the correct coarse-grained physical properties[1]. This allows us to study the interplay between hydrodynamic and Brownian fluctuations during steady-state sedimentation of hard sphere particles for Peclet numbers (Pe) ranging from 0.1 to 15. Even when the hydrodynamic interactions are an order of magnitude weaker than Brownian forces, they still induce backflow effects that dominate the reduction of the average sedimentation velocity with increasing particle packing fraction. Velocity fluctuations, on the other hand, begin to show nonequilibrium hydrodynamic character for Pe > 1. We also explore the effects of hydrodynamics on driven lane-formation and aggregation of colloidal suspensions.

[1] J.T. Padding and A. A. Louis, Phys. Rev. Lett. 93, 220601 (2004)