171d Many-Particle Hydrodynamic Interactions in Parallel-Wall Geometry: the Role of the Far-Field Flow

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Non-equilibrium behavior of colloidal suspensions confined between two parallel planar walls have recently been studied in numerous experiments. Theoretical descriptions and numerical simulations of such systems require accurate and efficient methods for evaluating many-particle hydrodynamic interactions in the parallel-wall geometry.

In this talk we will examine collective effects of the far-field flow produced by the particles. We will show that the backflow associated with the dipolar form of the far-field velocity may produce a strong positive feedback. This feedback mechanism results, for example, in the large magnitude of the resistance coefficient for linear chains of spheres moving in the direction perpendicular to their orientation. Similar effects have also been observed for arrays of spheres in external parabolic flow between the walls. A strong feedback mechanism is absent in free space, because the disturbance flow produced by a moving particle has the same direction as the particle velocity.

The backflow effects have important implications for development of evaluation methods for friction and mobility matrices in confined multiparticle systems: accurate and reliable evaluation techniques must take the far-field flow properly into account. The standard superposition approximation does not include the far-field backflow, and it thus fails completely for some particle configurations. We show how the results of our analysis can be used for efficient evaluation of multiparticle hydrodynamic interactions in wall-bounded systems.