Sound contributions to the short time dynamics of a quasi-1D colloidal suspension

D. Frydel and H. Diamant

Tel Aviv University, School of Chemistry, 69978 Tel Aviv, Israel,
E–mail: dfrydel@post.tau.ac.il

Description of colloidal dynamics on the level of the Smoluchowski equation assumes the diffusive time limit where other transport processes, such as ballistic motion and velocity relaxation, are coarse-grained. In this description, dynamics of the particles is differentiated into two distinct regimes: the short time dynamics determined by the hydrodynamic interactions, and the long time dynamics within which the configurational relaxation occurs and which is governed by the direct interparticle interactions. The hydrodynamic contributions in the short time regime is characterized by the wave dependent hydrodynamic function, $H(q)$.

In our work we investigate the short time collective dynamics of a colloidal suspension in a quasi-1D channel using the lattice-Boltzmann simulation. The tight confinement of a fluid gives rise to an effective friction in the Navier-Stokes description of a fluid. Consequently, the sound, unimportant in an unbounded fluid, change from a propagating to diffusive behavior, giving rise to an algebraic long time tail in the velocity correlation functions. This prolongation of the sound contributions alters the structure of the hydrodynamic function, $H(q)$, and undermines the assumption in the Smoluchowski description of the clear cut time scale separation. We investigate how the diffusive sound alters the function $H(q)$ and determine the time scale in which it might be observed.