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Collective dynamics and pattern formation in 2D regular arrays of spherical particles in Stokes flow between two parallel walls[1]
JERZY BLAWZDZIEWICZ, Yale University, ELIGIUSZ WAJNRYB, IPPT Warsaw, Poland, MATTHEW BARON, NIDHI KHURANA, Yale University — We present results of our numerical and theoretical investigations of collective dynamics of linear trains and regular square arrays of spherical particles suspended in a fluid bounded by two parallel walls. The simulations reveal propagation of particle-displacement waves, deformation and rearrangements of a particle lattice, propagation of dislocation-like defects in ordered arrays, and transitions between ordered and disordered regions that can coexist for a long time. We argue that ordered motion of the arrays is associated with the dipolar form of the quasi-2D asymptotic far-field flow produced by the particles. We also show that the overall deformation of the arrays can be described using a macroscopic theory where the array is treated as a 2D effective medium. The theory predicts a fingering instability near the array corners, and this instability is confirmed by our microscopic simulations.

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