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The Interplay of Solvation Forces with Lubrication Forces in Thin Gaps SIVAKUMAR CHALLA, University of New Mexico, FRANK VAN SWOL, Sandia National Laboratories — We report on the motion of a planar sphere approaching a smooth planar surface in a Lennard–Jones fluid using molecular dynamics simulations to understand the effect of solvation forces on the hydrodynamic drag experienced by the sphere. The hydrodynamic theory is found to be well representative of the force experienced by the sphere, even as close as 5–6 molecular lengths from the surface. Close to the surface, the solvation force is observed to be prominent in two regards, in the presence of molecular–length oscillations in the total force, and in some cases being also the predominant contributor to the total force on the sphere. The density distribution of the fluid particles close to the surface is characterized by strong layering, indicative of a breakdown of the continuum approximation in the hydrodynamic theory. Studies employing a range of sphere sizes and approach velocities indicate that the effect of the solvation force is most pronounced for slow approach velocities and for large spheres. Additionally, for analyzing experimental total force data, we suggest a phenomenological approach to decompose the total force on the sphere into a static component ("solvation force") and a dynamic component ("lubrication force",) which should be of interest in sedimentation processes and Atomic Force Microscopy.

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