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Elastohydromolecular forces on a sphere moving near a soft wall at low Reynolds numbers JAVIER URZAY, Department of Mechanical and Aerospace Engineering and Center for Energy Research, University of California San Diego (UCSD) — Boundary deformations are known to induce nonlinearities on the equations of viscous fluid motion and produce kinematically irreversible forces. The influence of soft boundaries and intermolecular London-van der Waals interactions on the forces experienced by a small sphere undergoing slow translation and rotation near a wall is investigated as a representative example of kinematic irreversibility using asymptotic and numerical methods. The clearance between the sphere and the wall is assumed to be small, so that the lubrication approximation holds in the gap. A general formulation, applicable to any azimuthal orientation angle of the rotation axis relative to the sphere translation axis and any constitutive wall equation, is developed and applied to a thin elastic layer coating a rigid surface. Expressions are derived for the irreversible lift force exerted on the sphere translating parallel to the wall, which include the influence of the azimuthal orientation of the axis of the rotation vector and its magnitude. Corkscrewing-like motions and wall-material incompressibility effects are also addressed. Attracting intermolecular London-van der Waals forces between the sphere and the deformable wall are found to produce an additional reversible elastohydromolecular drag force. The settling and migration motions are also briefly addressed.

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