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The Versatile Elastohydrodynamics of a Free Particle near a Thin Soft Wall THOMAS SALEZ, PCT Lab, UMR CNRS 7083 Gulliver, ESPCI ParisTech, PSL Research University, Paris, France, BAUDOUIN SAINTYVES, L. MAHADEVAN, SEAS, Harvard University, Cambridge, MA, USA — We address the free motion of a buoyant particle inside a viscous fluid, in the vicinity of a thin compressible elastic wall. After discussing the main scalings, we obtain analytically the dominant drag forces within the soft lubrication approximation. By including those into the equations of motion of the particle, we establish a general governing system of three coupled nonlinear and singular differential equations, that describe the three essential motions: sedimentation, hydroplaning, and hydrospinning, through four dimensionless control parameters. Numerical integration allows us to predict a wide zoology of exotic solutions – despite the low-Reynolds feature of the flow – including: spontaneous oscillation, Magnus-like effect, enhanced sedimentation, and boomerang-like effect. We compare these predictions to experiments. The presented elementary approach could be of interest in the description of a broad variety of elastohydrodynamical phenomena, including: landslides, ageing of cartilaginous joints, and motion of a cell in a microfluidic channel or in a blood vessel.

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