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Mobility of Membrane-Trapped Particles: Protrusion into the Surrounding Fluid

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Rheological and transport studies of model thin films and membranes, often inspired by biological systems, make use of translational or rotational motion or diffusion of particles trapped in the surface film. Here, the mobility of a disk-shaped particle, trapped in a Newtonian surface film, which is bounded on one side by a viscous Newtonian fluid, is considered for the case that the particle protrudes into the subphase. The finite protrusion of the membrane-bound particle into the subphase is the unique contribution of this work. Both the subphase and surface film contribute to the resistance on the particle and the relative contributions are calculated as a function of the degree of protrusion as well as the viscosity contrast between the surface film and the surrounding liquid. Experiments consistent with the theoretical results are discussed.

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