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Snail droplets: How fast is a flattened droplet transported by a more viscous wetting carrier fluid in a thin microchannel? FRANCOIS GALLAIRE, MATHIAS NAGEL, LFMI EPFL Lausanne — It has been known for more than hundred years that a spherical droplet of fluid #1 immersed in an unconfined environment of a more viscous carrier fluid #2 travels at a relative velocity outreaching the carrier fluid. This result does not hold when the droplet is squeezed in-between walls, an ubiquitous situation in microfluidics. Indeed, the presence of confining walls results in thin lubricating films of fluid #2 lying in-between the walls and the droplet interface, which introduce an additional source of drag that increases as the film thickness decreases. Following Park and Homsy (1984), the lubrication film thickness may be shown to vary as $Ca^{2/3}$ where Ca is the capillary number that compares the viscous damping and surface tension effects. These films also affect the pressure jump across the interface, which, combined with the Brinkman equations for the flow in Hele-Shaw cells, allows to determine the flow field and the resulting deformations of the droplet interface. The obtained results appear to be in good agreement with experimental measurements. A multipole expansion of the flow field created by the droplet is then coupled to the nonlinear boundary condition at the interface yielding a simple analytical expression for the relative droplet velocity.

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