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Geometrical effects for colloidal deposition on a fiber

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Drying a drop of a colloidal suspension is known to generate a transport of the particles towards the contact line, so-called the coffee-stain effect [1]. This transport is caused by the volume change, which triggers an internal flow to stay in the minimum of the surface tension energy, ie a spherical cap for a sessile drop [2,3].

In this presentation, we will discuss the evaporation of colloidal drops on fibers; a configuration bringing a particular role of the geometry. Indeed, the curvature imposed by the fiber on the drop leads to a liquid morphology that is different of a spherical cap for sessile drop [4]. We show experimentally the consequences of the liquid morphology on the colloidal transport: the drop has two distinct contact lines, the particle motion toward them is significantly slower, and the contact line depinning occurs well before the total evaporation, in contrast to sessile droplets. We propose a phenomenological model to rationalize these observations. Finally, we discuss how this finding modifies the common sense that the community developed over the past 20 years.

[1] Deegan, Bakajin, Dupont, Huber, Nagel, Witten, Nature, 1997, 389, 827-829
[2] Popov, Phys. Rev. E, 2005, 71, 036313.
[3] Boulogne, Ingremeau, Stone, Journal of Physics: Condensed Matter, 2017, 29, 074001
[4] Carroll, Journal of Colloid and Interface Science, 1976, 57, 488 - 495

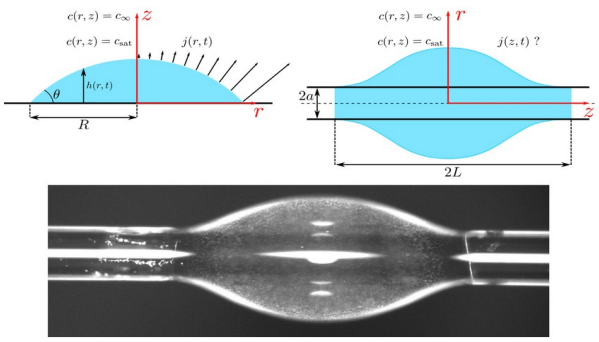

Figure 1 : Top left: evaporating sessile drop, the well-studied situation for the coffee stain effect. Top right: evaporating drop on a fiber, the fiber curvature leads to a different drop shape. Bottom: image of a drop containing micron-size fluorescent particles, evaporating on a fiber (200 µm diameter).