Liquid dynamics in confined space: About the influence of the boundaries to droplets and other small liquid structures

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Flow processes of liquids on small scales gain an increasing attention due to lab-on-a-chip applications. As a result, the interactions at the interface between a solid and a liquid and their effects on the stability and the flow dynamics of thin liquid films denote essential questions.

The talk focusses on characterizing the impact of the hydrodynamic boundary condition at the solid/liquid interface on droplets and ridges. First, the Rayleigh-Plateau-Instability (RPI) of a liquid film on a cylindrical fibre is studied. The variation of the boundary condition (sli/no slip) revealed a significant influence on the dynamics of the RPI [1]. It is also found that the late stage of the RPI on a hydrophobic fibre provides moving droplets. That enabled the quantitative examination of the capillary-driven liquid transport along a fibre [2]. The boundary condition moreover influences the flow of a droplet: Classical hydrodynamic models predict that infinite work is required to move a three-phase contact line. Assuming a slip boundary condition, in which the liquid slides against the solid, such an unphysical prediction is avoided. Results of experiments will be presented in which a contact line moves and where slip is a dominating and controllable factor [3]: Spherical cap-shaped droplets, with nonequilibrium contact angle, are placed on solid from which they dewet. The relaxation is monitored using in situ atomic force microscopy.We find that slip has a strong influence on the droplet evolutions, both on the transient nonspherical shapes and contact line dynamics. The observations are in agreement with scaling analysis and boundary element numerical integration of the governing Stokes equations, including a Navier slip boundary condition. Yet why does a liquid slide? Possible explanations including recent findings by scattering methods [4] will be reviewed.

[1] S. Haefner et al. *Nature Comm.* 6 (2015) 7409,

[2] S. Haefner, O. Bäumchen, K. Jacobs, *Soft Matter* 11 (2015) 6921,

[3] J.D. McGraw et al. *PNAS* 113 (2016) 1168, [4] J.D. Mc Graw et al, *J. Chem. Phys.* 146 (2017) 203326