Chair: Physics of Fluids group

Spreading of liquid drop on a fluid-fluid interface

Description

The dynamics of a moving three-phase contact line formed at a junction of solid-liquid-gas phases is a topic of long-standing research. We encounter contact lines in our daily lives as well as numerous industrial processes (Bonn et al., 2009). Inspired from the recent studies in which underlying universality of moving contact lines on a solid surface have been discussed, we aim to study the dynamics of a triple-phase contact line formed at a junction of two immiscible liquids and a gas phase. The critical difference in the two cases is that contrary to the motion of a contact line on an undeformable solid, the liquid-gas interface beneath the contact line deforms in the latter case. The characteristics of this deformation and interfacial properties have a crucial influence on the spreading dynamics (Rahman et al., 2018).
We plan to use a combination of experiments and numerics to investigate the dynamics of moving contact lines on a liquid-gas interface. The scope of the project allows the student to get hands-on experience in designing experiments as well learn a few tricks in the numerical computations as well.

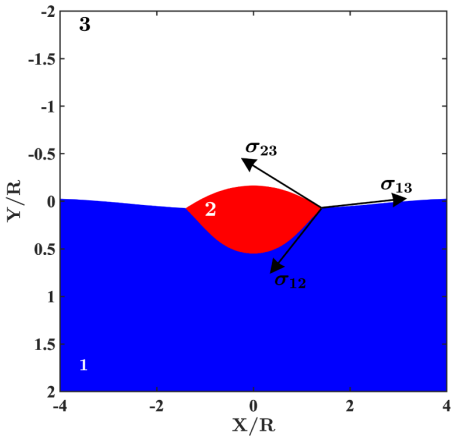

Figure 1: Schematic of the process.

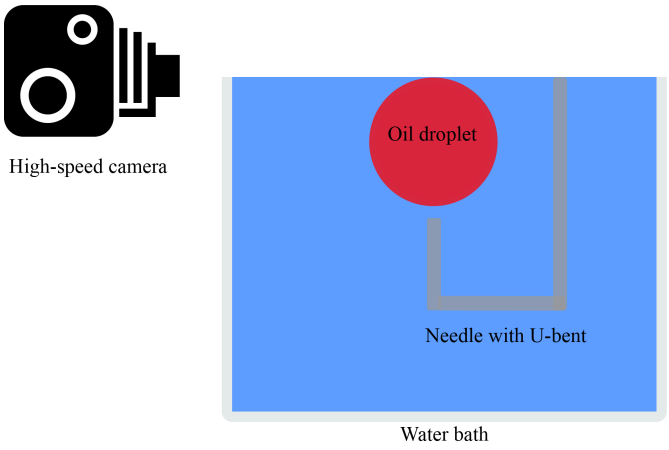

Figure 2: Schematic of the experimental setup.

What will you do & what will you learn?

The project will focus on the following:

1. Design an experiment to visualize spreading of an oil droplet on the water-air interface, as shown schematically in the Figure 2. (**Skills:** Experimental techniques involving high-speed imaging, fluorescent microscopy, etc.)

2. Determine scaling laws governing the spreading of a droplet on a fluid-fluid interface and compare it with the spreading on a solid surface. (**Skills:** Fundamentals of two-phase interfacial dynamics.)

3. One to one comparison between experimental results and numerical simulations. (**Skills:** C/C++ & Matlab or similar scripting language)

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References

Bonn, Daniel, Jens Eggers, Joseph Indekeu, Jacques Meunier, and Etienne Rolley (2009). "Wetting and spreading". In: *Reviews of modern physics* 81.2, p. 739.

Rahman, Muhammad Rizwanur, Haritha Naidu Mullagura, Bharath Kattemalalawadi, and Prashant R Waghmare (2018). "Droplet spreading on liquid–fluid interface". In: *Colloids and Surfaces A: Physicochemical and Engineering Aspects* 553, pp. 143–148.