Merging drops with unstable wetting films

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Fusion or merging of drops plays a key role in many different processes such as raining and coating. Due to this fact, in recent years, it has been widely studied experimentally, theoretically and numerically. Physics of fluids stipulates that after coming in contact, two drops merge to reduce interfacial energy. However the pathway might be complex [1], [2]. When two immiscible drops merge, depending on the surface and interfacial tensions, a liquid film of the drop with lower surface tension might be drawn over the surface of the other drop, i.e. the spreading coefficient can be positive. Since in most of applications like inkjet printing, two non-identical drops come to contact, studying this phenomenon has attracted a lot of attention recently.

In current study, the drops are deposited on a glass substrate via two independent syringe. We present results for pure water and cyclohexyl bromide. A high-speed camera enables us to capture the process. The flow field inside the drops is investigated by the use of tracer particles. First a water droplet is deposited on the substrate and then cyclohexyl bromide is injected as the second drop. A thin liquid film of cyclohexyl bromide covers the water droplet surface. To some extent, this behavior does not depend on the order in which the drops are placed.

In our case, these liquid films exhibit and instabililty that resembles the Rayleigh–Plateau instability (Fig. 1), which is responsible of breakup and atomization of liquid sheets [3]. We present a deatiled study of this instability analyzing the onset of instability, the length of liquid film and characteristic wave length of instability as function of physical parameters. To measure the instability characteristics, the captured images are analyzed by ImageJ software. The results show that the instability only occurs when a cyclohexyl bromide drop comes to contact with pre-deposited water drop. If the cyclohexyl bromide drop is deposited first, no instabililty is observed. However the final configuration of both processes is same, the pathway is totally different.

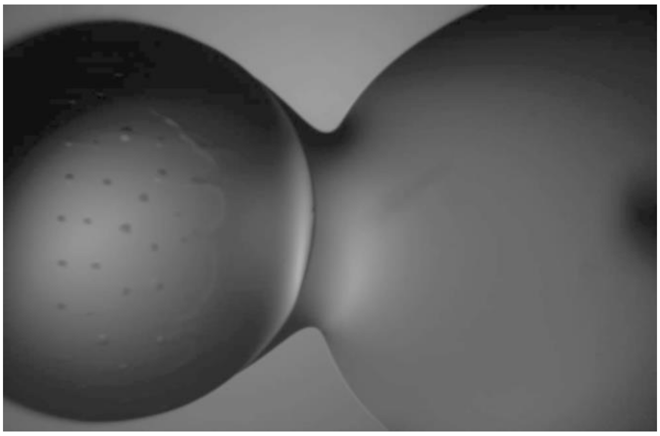

Fig. 1:
A cyclohexyl bromide drop (right) in contact to a water drop (left). A positive spreading coefficient pulls a thin film of cyclyhexyl bromide over the water drop. This film however becomes unstable and disintegrates into drops.

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[2] S. Karpitschka and H. Riegler, "Sharp transition between coalescence and non-coalescence of sessile drops," *J. Fluid Mech*. **743**, (2014).
[3] R. Krechetnikov, "Stability of liquid sheet edges," *Phys. Fluids*. **22**, (2010), 092101.