Flow inside Fakir Droplets

The life of a evaporating droplet can be a bit boring. But when we look inside them, there is a lot we still do not understand. This is specially true for *fakir droplets*: droplets that stand over very rough and sharp micro- and nanostructures, with such low contact with the solid surface, that they remain practically spherical. This is something you can easily see in nature in water droplets on leaves, condensated after a cold night or deposited after some rain. Such spherical droplets are special in many ways, an important one is that their evaporation is the strongest at their top, which cools them down locally, and they become a bit warmer at the bottom, where they are in contact with the solid surface and the evaporation is the lowest. This temperature difference should induce a convection flow, but this is very difficult to see.

To make things even more complicated, water droplets suffer easily from interfacial contamination, which affects dramatically such kind of flows. One way to study these systems is using numerical simulations, in which we can add an arbitrary amount of contamination. However, we need experimental data to tune the amount of contamination used in simulations.

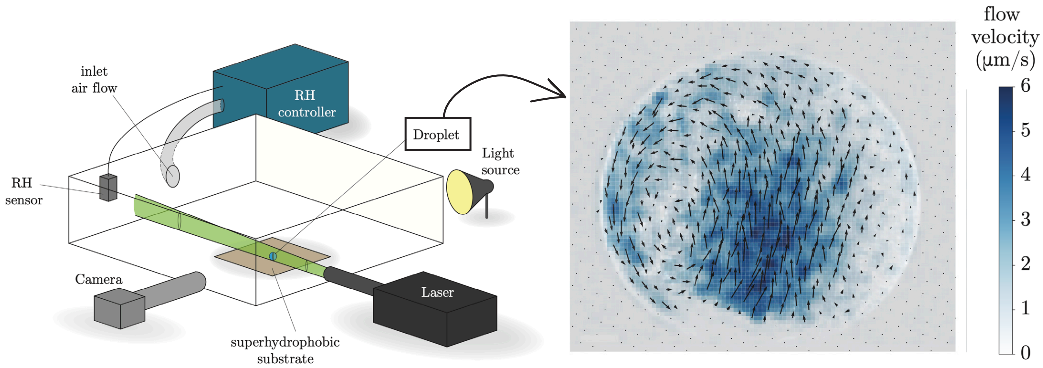

Figure 1: Left: a sketch of the experimental setup to be used. Right: Some preliminary results by Carola Seyfert [1] using PIV in that setup. The observed internal flow is persistent and clearly measurable.

Your mission, should you choose to accept it, will be to visualise the flow inside these fakir droplets by seeding them with fluorescent particles, and illuminating them using a thin laser sheet; a long distance microscope will be used to acquire the images (as in figure 1-left). This will be done under different ambient conditions of temperature and relative humidity, which we will be able to modify using a temperature/humidity controller. The images will be first processed to compensate for the droplet shape using ray tracing, and the flow field obtained using particle image velocimetry or particle tracking (figure 1-right).

The project will be supervised by Pim Dekker and Alvaro Marin, but we will also discuss frequently with Duarte Rocha and Christian Diddens, who take care of the numerical simulations.

Supervision	**Contact**	**Role**
Pim Dekker	p.dekker@utwente.nl	(daily)Supervisor
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[1] Carola Seyfert. Shaping droplets: Colloids and instabilities. 2022. URL `https://doi.org/10.3990/1.9789036553070`.