Probing viscosity and surface energy of microscopic droplets in a liquid (M.Sc. Project)

Research question:

Can we measure properties of microscopic droplets in liquids using optical tweezers?

Project Description:

Remotely measuring properties of liquids using levitation is commonly used applications where touching the liquid is not an option, like molten steel or aerosols. For example by applying a mechanical excitation to a levitated droplet of liquid ("giving it a kick") and measuring its response we can measure its surface tension and viscosity.

We have implemented this approach in our group using an acoustic levitator and we use it to study properties droplets of colloidal suspensions and their complex temporal dynamic. The typical size of the droplets that can be probed with acoustic levitation is around 1 mm.

There is a wide variety of very important biological and chemical processes involving emulsions and vesicles with the sizes from 10 micrometers to less than 100 nanometers, whose properties are dependent on environment in which they are e.g. vesicles in blood. The properties of such objects are very interesting for biology and chemistry, yet there are often hard to study.

In this project we aim to develop a method based on the remote measurement of droplets, but implemented now in the optical tweezers, which will allow trapping of objects of roughly one micrometer.

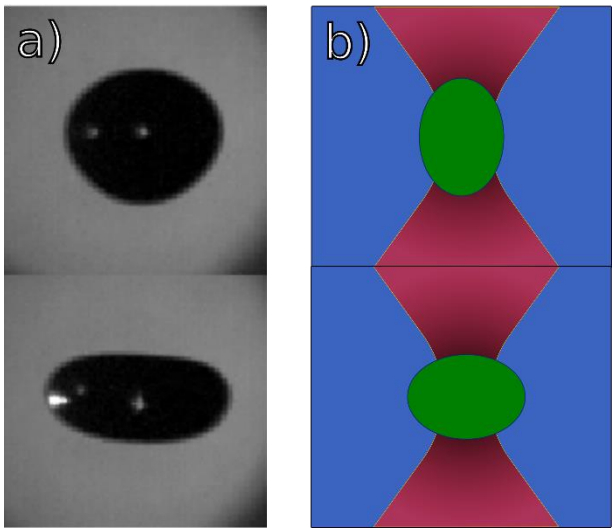

Figure 1. Free decaying oscillation of a droplet a) as photographed in the acoustic levitator setup b) as proposed in the optical tweezers setup

In this project, you will have a chance to take part in developing new experimental method and learn about optical tweezers, acoustic levitation, microfluidics, and rheology of complex liquids.

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