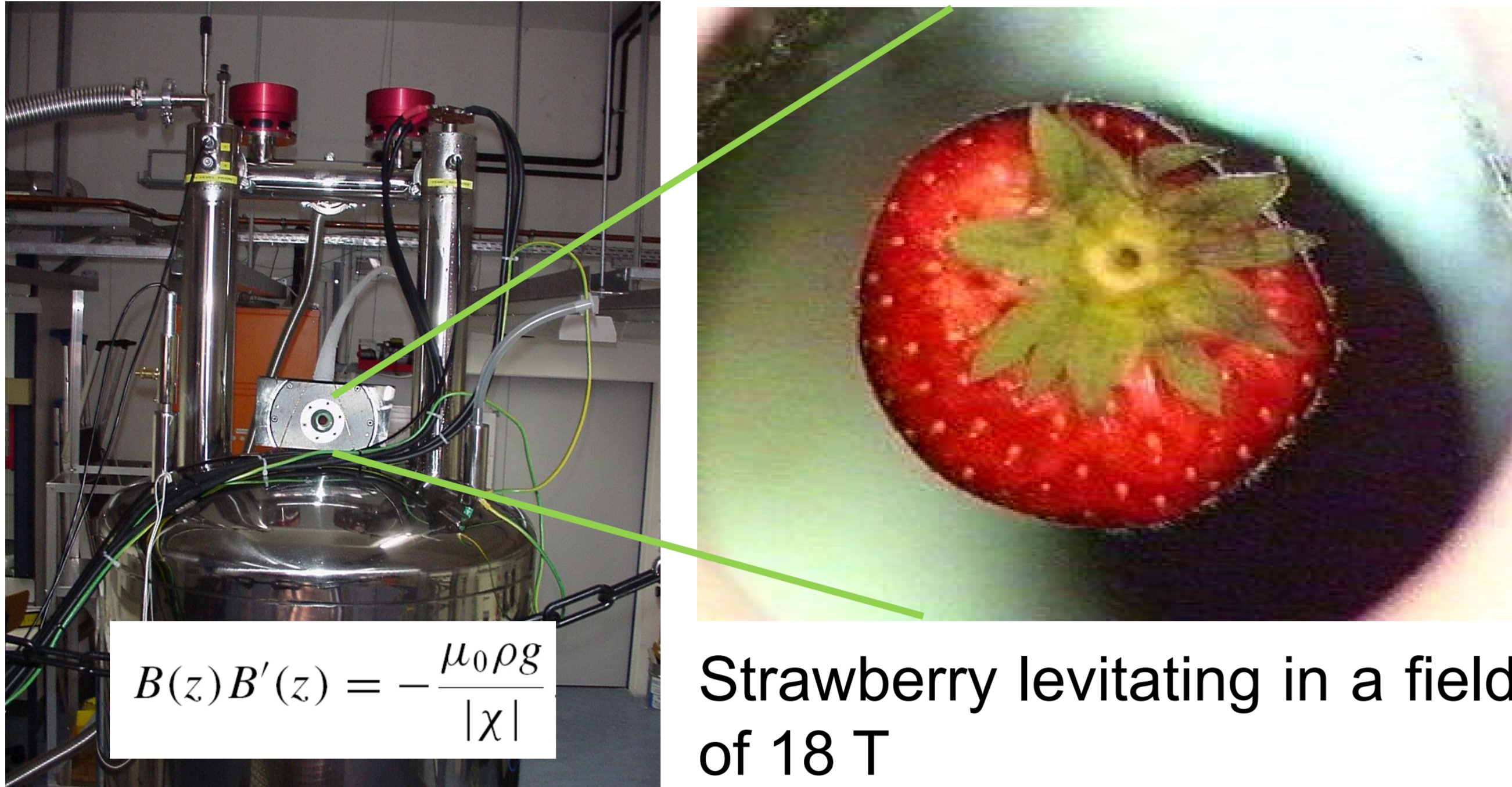




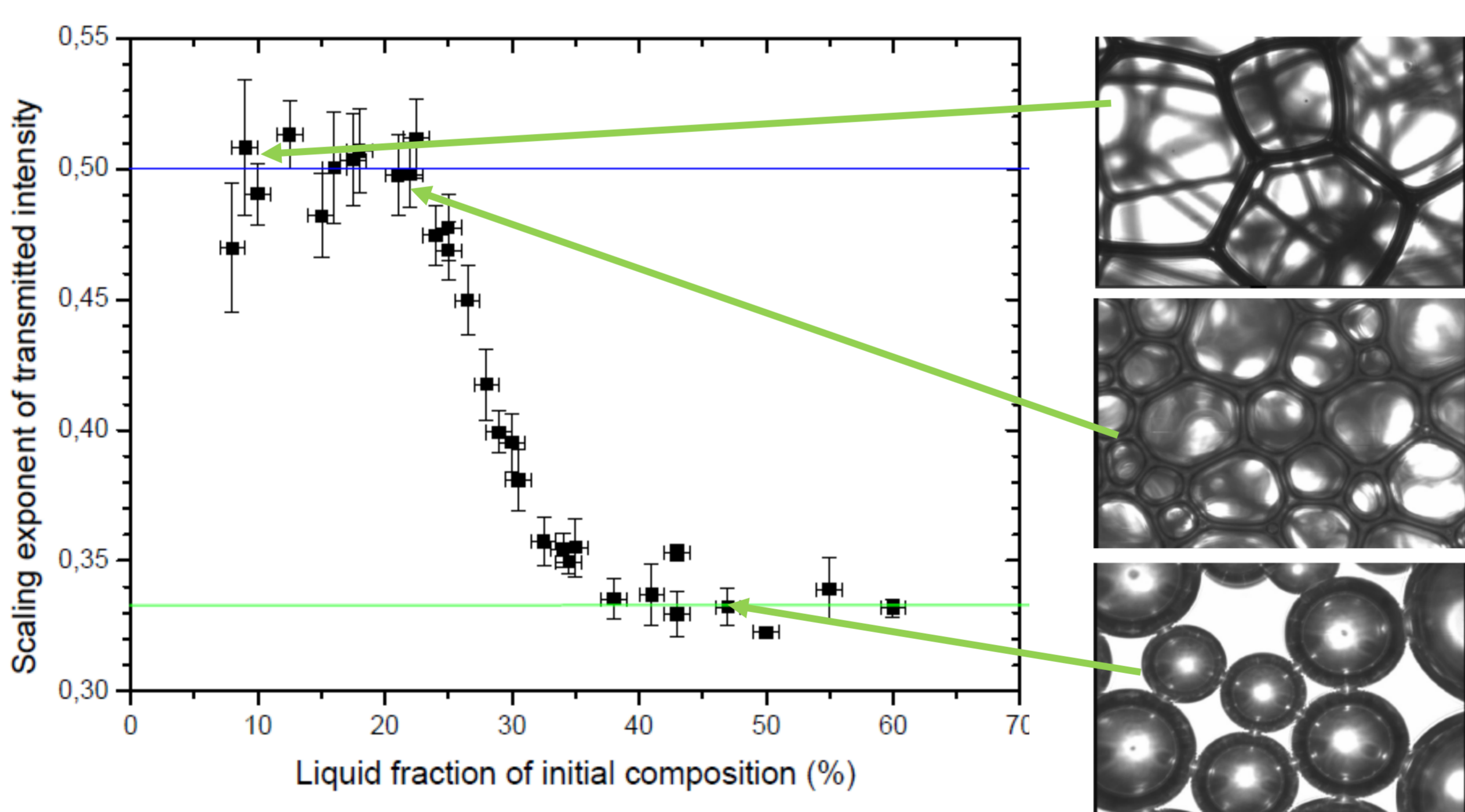
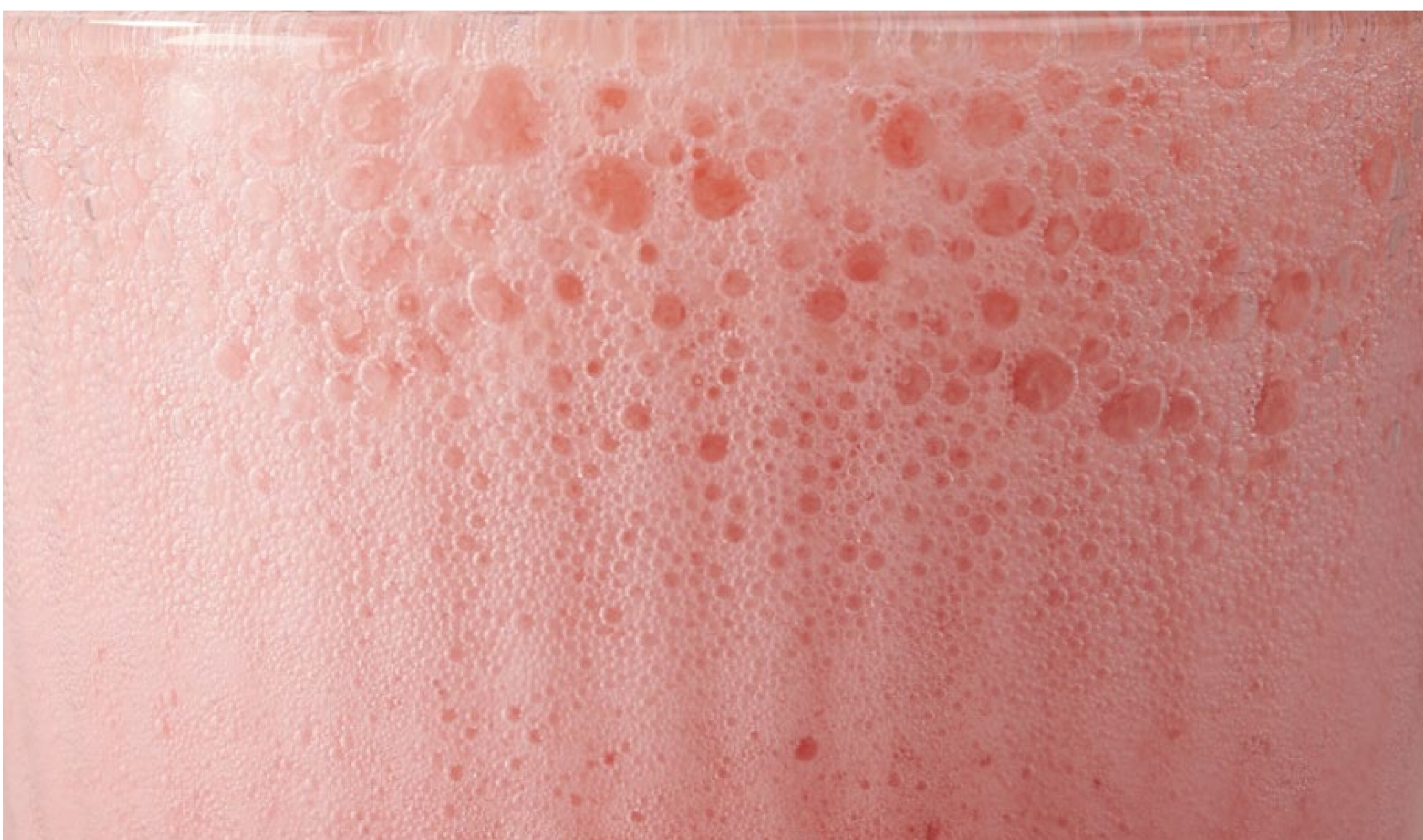
Levitated non-equilibrium systems

Many non-equilibrium systems are forced to a stable point by gravity. We counteract gravity by a compensating body force in diamagnetic levitation. Thus samples of diamagnetic materials levitate stably for days or weeks, similar to the space station.

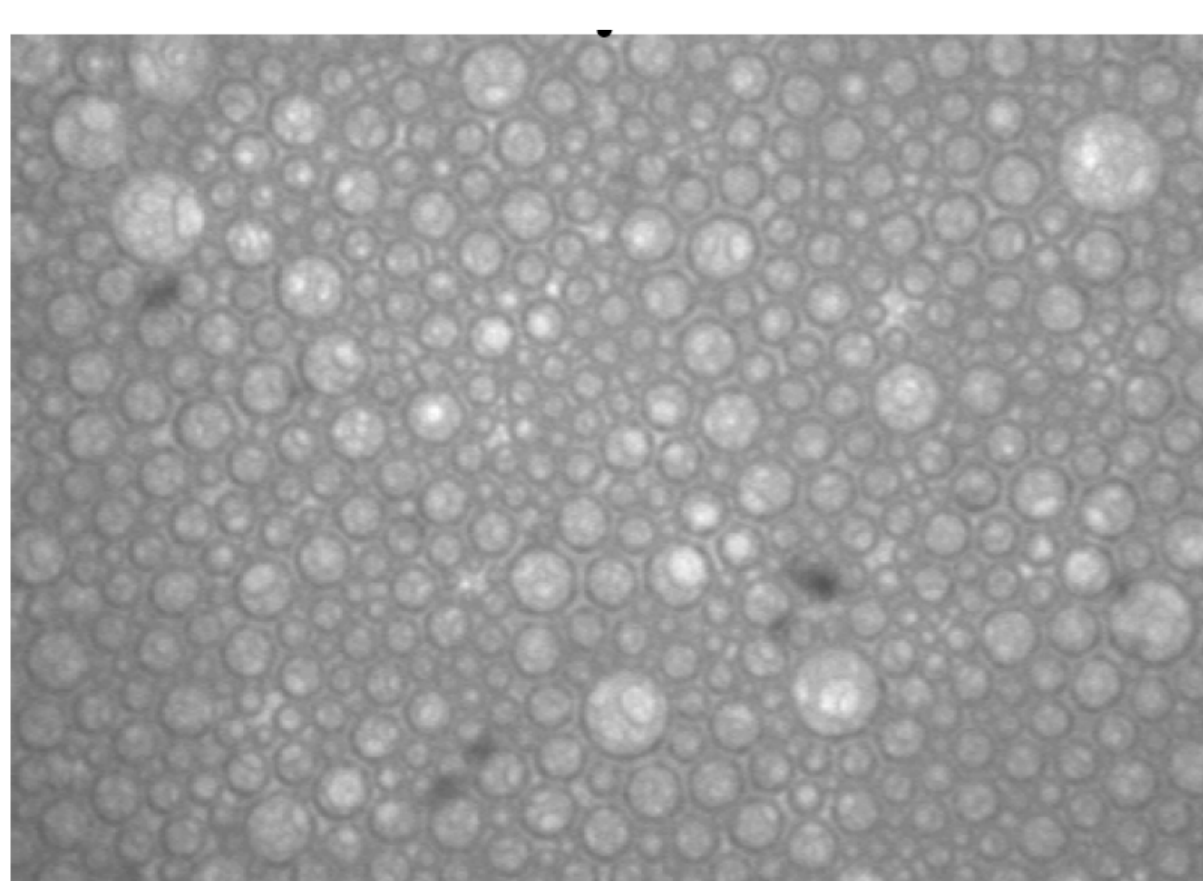


Strawberry levitating in a field of 18 T

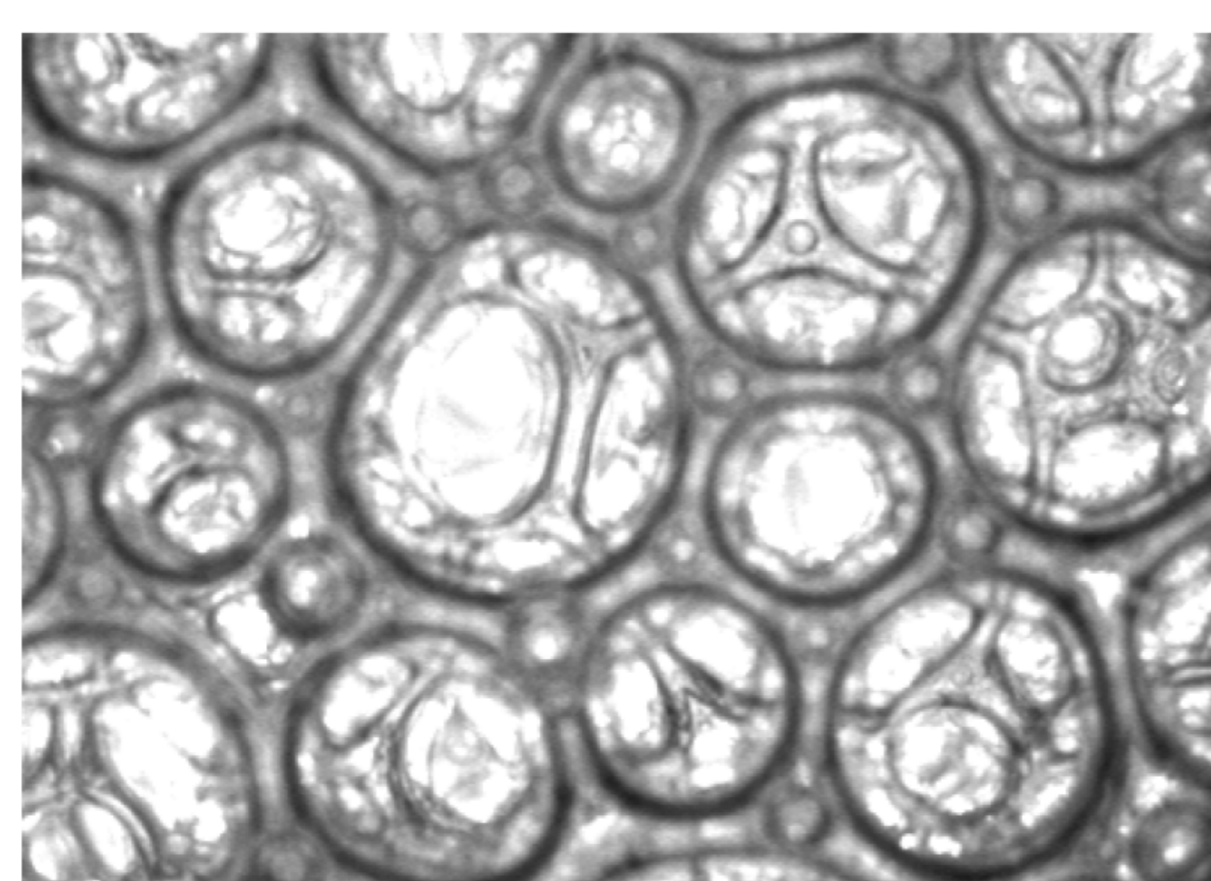
For instance when observing the foam of a drink, fluid flow due to gravity creates a gradient of varying liquid fraction with very different structural properties. These can be studied separately when levitating the foam.



At liquid fractions of 25%, where close packing of spheres is reached, the foam goes through a phase transition. The structural characterisation of this transition together with its rheological properties is what you will study in this project.



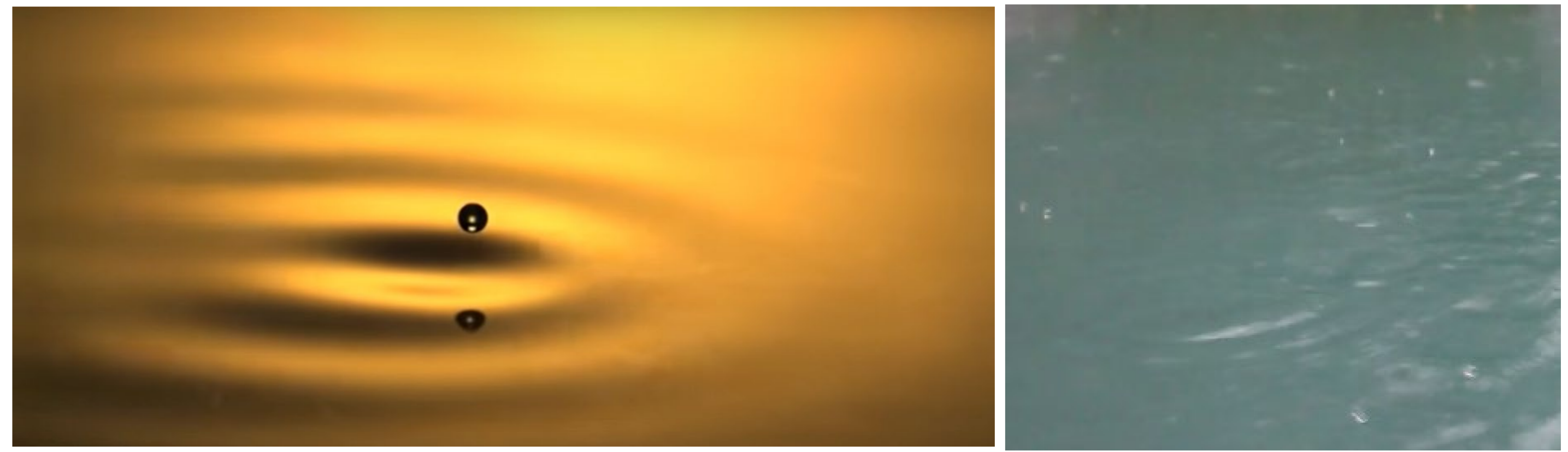
10 minutes after foam creation



150 minutes after foam creation

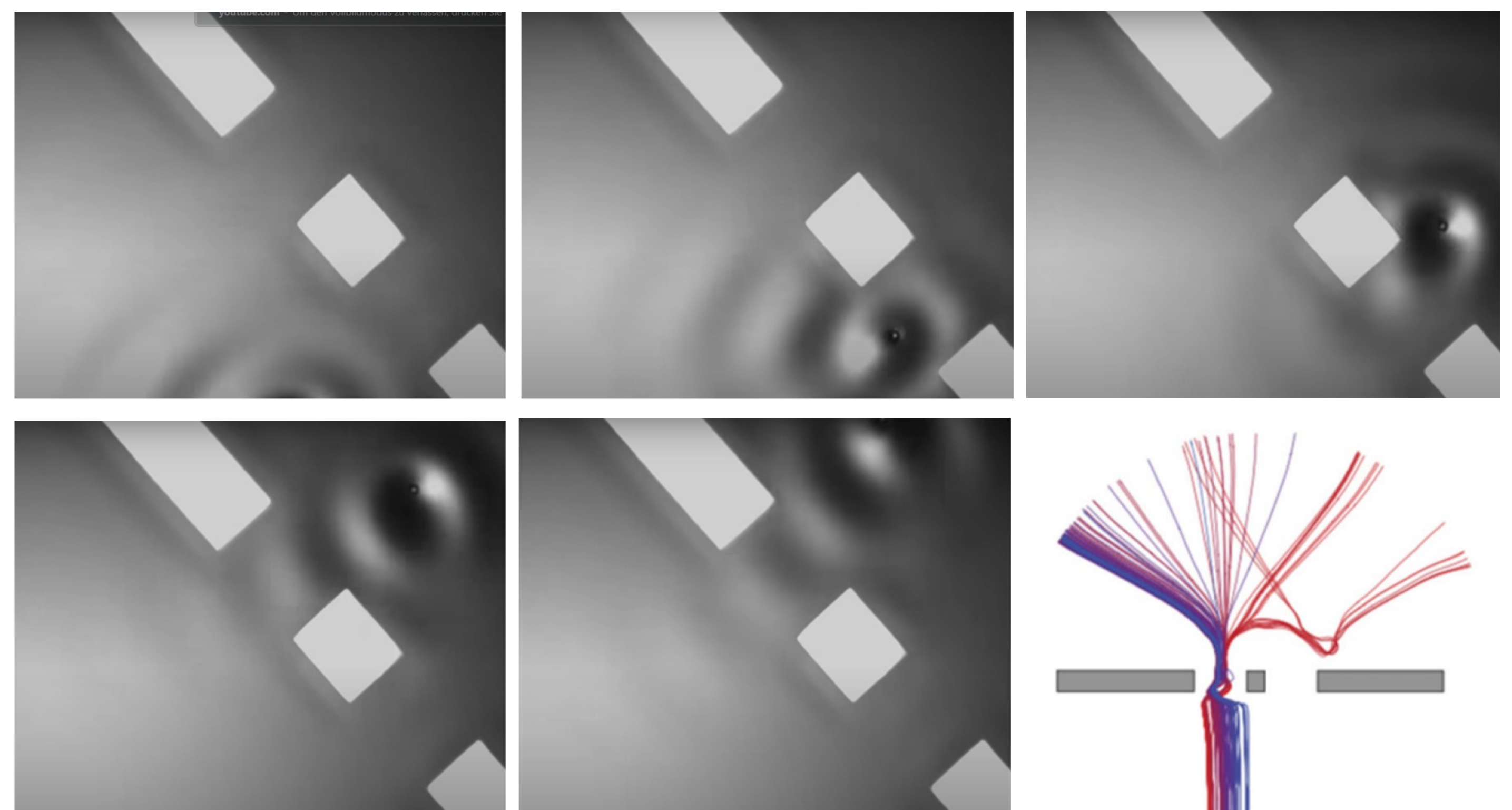
Plotted above is the growth exponent of foam bubbles, which can for instance be determined from direct imaging of the surface of the foam.

Macroscopic Wave-particle duality



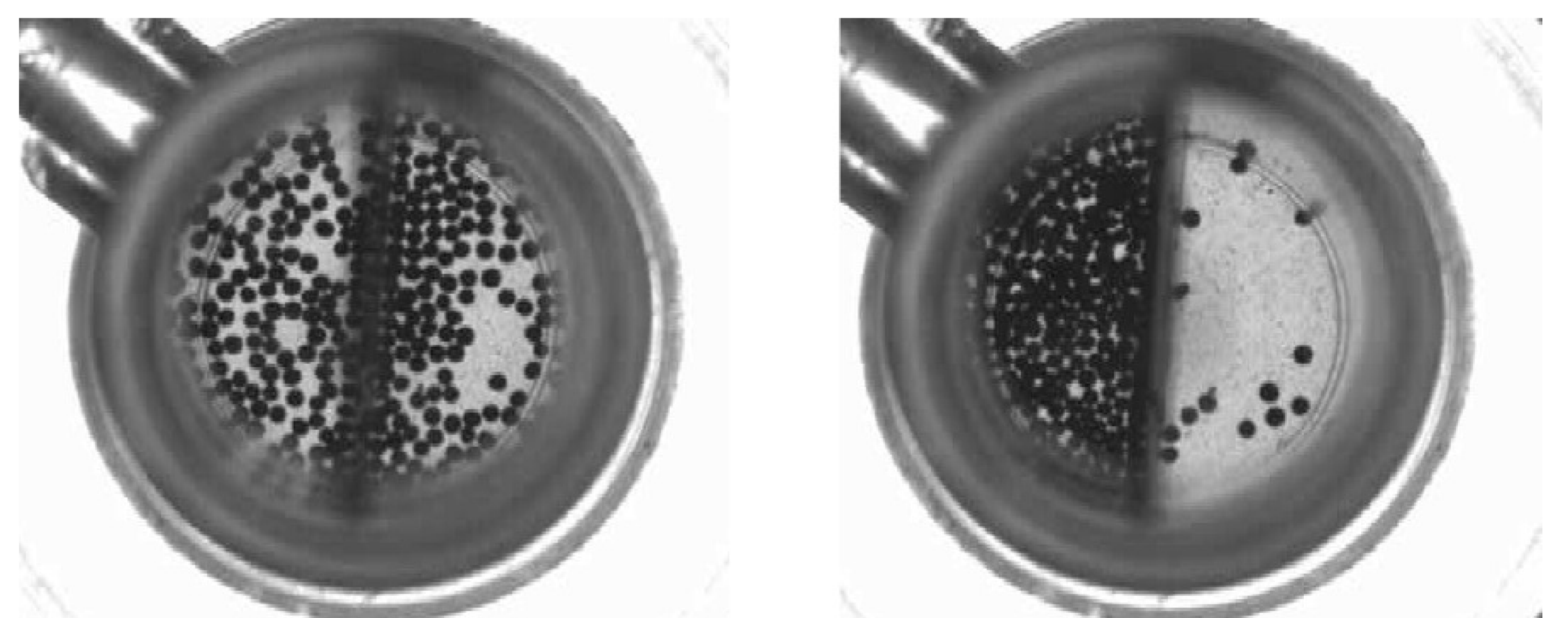
Liquid surfaces are unstable to vertical oscillation, showing standing wave patterns known as Faraday instability. Close to this instability, droplets of the same liquid can travel across the surface, by creating such a wave, which guides the motion of the droplet.

Such droplets can thus demonstrate aspects of wave-particle duality at the macroscopic stage, such as single-particle interference. This project sets up such a demonstration experiment.



Phase transitions and self-organized criticality in granular systems

Shaken granular systems show non-equilibrium phase transitions, such as spontaneous sorting as shown below. Extending the system to several compartments in an annulus, travelling waves of clusters can be observed with critical behaviour akin to absorbing state phase transitions.



This can be connected to self-organized criticality (SOC), describing the avalanches in a sand pile, where the same underlying dynamics appears. Thus, such systems can be used to quantitatively map self-organized critical behaviour to absorbing state phase transitions, which clarifies the origin of criticality in SOC.

