14th MSS-Seminar

Wednesday, March 30th, 15:30, Nägelsbachstr. 49b

Supersonic air jets, nanopumps, and microwave heating

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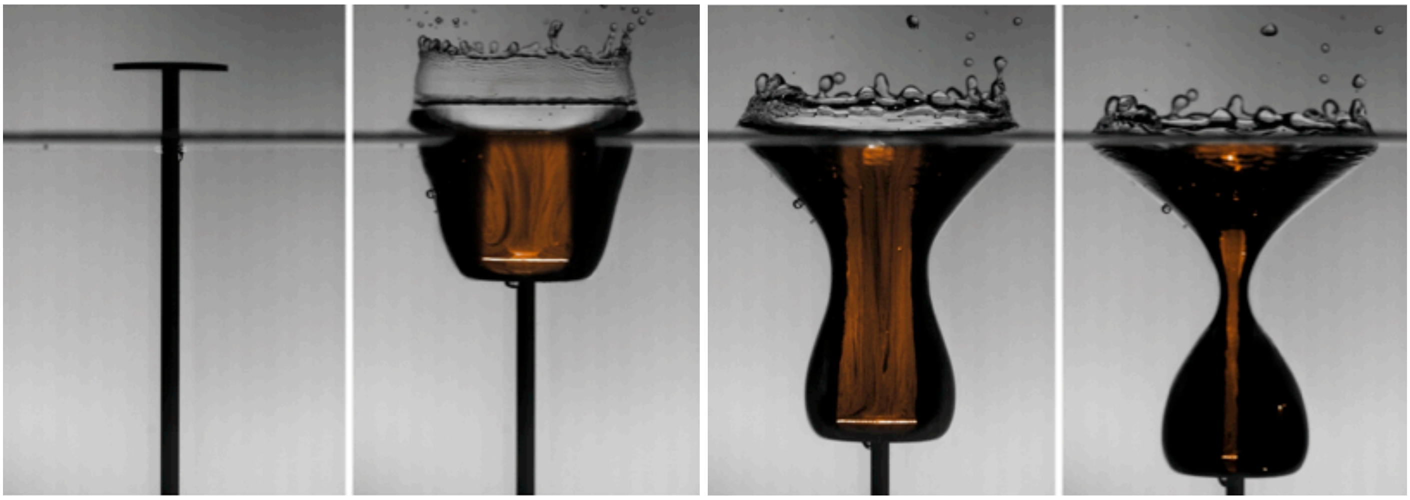

This talk will consist of two parts. In the first part, I will treat the impact of a solid object on a liquid surface. Using visualization experiments with smoke particles and numerical simulations (combining a boundary-integral method with a compressible Euler solver) we show that – in addition to the familiar liquid jet – a high-speed air-jet is pushed out of the cavity. Despite an impact velocity of only 1 m/s, this air-jet can easily attain supersonic speeds. The structure of the air flow resembles closely that of compressible flow through a nozzle – with the key difference that here the "nozzle" is a liquid cavity shrinking rapidly in time. In the second part, I will change subject and show some recent work where we use molecular dynamics simulations to study the response of confined, nanoscopic water to time-dependent electric fields. In one setup we illustrate how electric fields can couple to the water dipoles and thereby pump even pure water through tiny nanometric tubes (carbon nanotubes, CNTs). Such tubes can nowadays routinely be fabricated. Our proposed setup is a prototype of a simple, efficient, and practically realizable nanofluidic pump without any mechanical parts and may represent a promising base for future microscopic filtration devices. Another prominent application of electric fields is dielectric (microwave) heating. The basic mechanism – the rotation of the water molecules induced by an alternating electric field – is well understood and used in millions of kitchen microwaves around the world. If time permits, I will show in this final part that for a nanometer thin layer of interfacial water the absorption characteristics can substantially differ from their corresponding bulk values.