Nov. 18th, 2019

Pre-lecture Reception: 4:30pm
Lecture: 5:00pm
Building 1-190

Faculty Host: Prof. Lydia Bourouiba

Abstract

In this talk, I will show several examples of an interesting and surprising competition between buoyancy and Marangoni forces. First, I will introduce the audience to the jumping oil droplet – and its sudden death – in a density stratified liquid consisting of water at the bottom and ethanol at the top. After sinking for about a minute, before reaching equilibrium, the droplet suddenly jumps up thanks to Marangoni forces. This phenomenon repeats about 30-50 times, before the droplet falls dead all of the sudden. We explain this phenomenon and explore the phase space where it occurs.

Next, I will focus on the evaporation of multicomponent droplets, for which the richness of phenomena keeps surprising us. I will show and explain several of such phenomena, namely evaporation-triggered segregation thanks to either weak solutal Marangoni flow or gravitational effects. The dominance of the latter implies that sessile droplets and pending droplets show very different evaporation behavior, even for Bond number \( \ll 1 \). I will also explain the full phase diagram in the Marangoni number vs Rayleigh number phase space, and show where Rayleigh convection rolls prevail, where Marangoni convection rolls prevail, and where they compete.

The research work shown in this talk combines experiments, numerical simulations, and theory. It has been done by and in collaboration with Yanshen Li, Yaxing Li, and Christian Diddens, and many others.

Biography

Detlef Lohse received his PhD on the theory of turbulence in Marburg/Germany. As a postdoc in Chicago and later in Marburg and München he worked on single bubble sonoluminescence and then appointed as Chair of Physics of Fluids at the University of Twente, The Netherlands. Prof. Lohse is also Member of the Max Planck Society and of the Max-Planck Institute in Göttingen and Honorary Professor at Tsinghua University, Bejing. Prof. Lohse is known for his exceptional contributions in the most diverse fields of fluid dynamics, such as the transition between different turbulent regimes in Rayleigh-Bénard convection, Taylor-Couette turbulence, the study of multi-phase turbulent flow, sonoluminescence, inkjet printing, the properties of bubbles and drops down to a microscopic level, and micro- and nanofluidics. His research covers both fundamental and more applied science and combines experimental, theoretical, and numerical methods.

Prof. Lohse is Editor of several journals, including leading journals in the field, such as the J. Fluid Mech. and Ann. Rev. Fluid Mech. He is a Fellow of the American Physical Society—Division of Fluid Dynamics, a Member of the (American) National Academy of Engineering, the Dutch Academy of Sciences (KNAW), the German Academy of Sciences (Leopoldina). He received various scientific prizes, including the APS Fluid Dynamics Prize, the Spinoza Prize (NWO), the Simon Stevin Meester Prize (STW), the AkzoNobel Science Award, the George K. Batchelor Prize (IUTAM), the Balthaz Prize. In 2019, he received the Max Planck Medal, the highest international award for theoretical physics of the German Physical Society, for his research on the physics of bubbles and on turbulence, joining other physicists like Albert Einstein, Niels Bohr and Erwin Schrödinger who received the medal, and the first given in fluid dynamics.