Date: November 16th

Time: 11:00 AM

Location: Maryland Hall 110

Speaker: Dr. Detlef Lohse

University of Twente

Title: *"Zipping wetting - and other surface phenomena"*

Abstract

Micro-structured materials can show a superhydrophobic behavior with effective contact angles of 160^o and beyond (“Lotus effect”), while the contact angle of the smooth surface is much smaller. Such materials are used e.g. for medical applications, coatings, self-cleaning, textiles, and microfluidics. However, under certain conditions, the superhydrophobicity (“Cassie-Baxter state”) spontaneously breaks down: fluid enters in between the micro-structures and spreads, resulting into a smaller contact angle (“Wenzel state”). Ultra-high-speed imaging allows us to analyze the dynamics of this breakdown. Depending on the scales of the micro-structure, the wetting fronts propagate smoothly and circularly or -- more interestingly -- in a stepwise manner, leading to a growing square-shaped wetted area: entering a new row perpendicular to the direction of front propagation takes milliseconds, whereas once this has happened, the row itself fills in microseconds (“zipping”). The time scale separation of this zipping-wetting originates from a divergence in the characteristic wetting time (critical slowing down) which can analytically be derived by balancing capillary and viscous effects. Numerical simulations confirm this view and are in quantitative agreement with the experiments. Our results provide design criteria for superhydrophobic surfaces.

In the second part of the talk we focus on the opposite effect, namely bubble nucleation at surfaces which is a poorly understood phenomenon. We did visualization experiments at structured hydrophobic surfaces and compared the results with model calculations, in particular focusing on bubble-bubble interactions. It is demonstrated that in the many bubble case the bubble collapse is delayed due to shielding effects. We succeed in making cavitation totally reproducible in space and time. Finally, we will address the question on whether surface nano-bubbles play a role in the bubble nucleation.