**Dr. habil. Fathollah Varnik**

*ICAMS, Ruhr-Universität Bochum*

## Lotus effect revisited: Fall and rise of small (rain) drops on superhydrophobic surfaces

In this talk, we first review physical principles of superhydrophobicity and introduce the concept of metastability for the behavior of (rain) drops on rough or topographically patterned hydrophobic surfaces. Interestingly, while the behavior of large drops on patterned hydrophobic surfaces has obtained considerable attention in the literature, experiments/theoretical calculations regarding the limit of small droplets are hardly available. Here, a drop is defined to be small if its radius is comparable to the typical roughness scale (e.g. the mutual distance between pillars in a regular array). In view of the fundamental relevance of small droplets for the condensation and evaporation process, we focus on this issue and present our recent findings [M. Gross, FV, D. Raabe, Europhys. Lett. (2009)]. Along this line, we first introduce a simple, analytically solvable, model allowing to explore the whole stability phase diagram of small drops on a regular array of pillars. This simple model leads to two important predictions. First, we uncover the existence of a new state, intermediate to the well-known Cassie-Baxter (CB, where the droplet resides on top of the pillars) and the fully wetting Wenzel (where the drop completely fills the region between the pillars) states. The new state is characterized by a finite penetration depth of droplet into the grooves while it is still not touching the bottom of the substrate. Furthermore, the dependence of the penetration depth on droplet size leads to a second prediction, namely that a quasi-statically evaporating droplet, may first be in the CB state, then undergo a transition to the intermediate impaled state and upon further evaporation, instead of fully sinking into the grooves, go back to (re-enter) the CB state again. Both the above predictions are observed within an independent numerical approach, the lattice Boltzmann computer simulations. Some important implications of this phenomenon are discussed.