Small droplets on superhydrophobic substrates

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We investigate the stability of liquid droplets on a regular superhydrophobic substrate for the case of droplets that are of comparable size to the surface asperities.

We propose a simple analytic three-dimensional free energy model that is
capable of explaining all the essential results. The stability of the fakir state is shown to depend on the substrate geometry, contact angle and droplet size. We are able to observe a new stable state of partial impalement that is different from the fakir state. Furthermore, we find that, due to this new state, an evaporating droplet can be saved from going over to the Wenzel state and instead remains close to the top of the surface texture.
Our analytic calculations are in very good agreement with results obtained from lattice Boltzmann computer simulations.