Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Low-order modelling of droplets on hydrophobic surfaces[1] OMAR MATAR, ALEX WRAY, LYES KAHOUADJI, Imperial College London, STEPHEN DAVIS, Northwestern University — We consider the behaviour of a droplet deposited onto a hydrophobic substrate. This and associated problems have garnered a wide degree of attention due to their significance in industrial and experimental settings, such as the post-rupture dewetting problem. These problems have generally defied low-order analysis due to the multi-valued nature of the interface, but we show here how to overcome this in this instance. We first discuss the static problem: when the droplet is stationary, its shape is prescribed by an ordinary differential equation (ODE) given by balancing gravitational and capillary stresses at the interface. This is dependent on the contact angle, the Bond number and the volume of the drop. In the high Bond number limit, we derive several low-order models of varying complexity to predict the shape of such drops. These are compared against numerical calculations of the ODE. We then approach the dynamic problem: in this case, the full Stokes equations throughout the drop must be considered. A low-order approach is used by solving the biharmonic equation in a coordinate system naturally mapping to the droplet shape. The results are compared against direct numerical simulations.

[1]EPSRC Programme Grant, MEMPHIS, EP/K0039761/1, EPSRC Doctoral Prize Fellowship (AWW)

Omar Matar
Imperial College London

Date submitted: 27 Jul 2015 Electronic form version 1.4