Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

The resolution of the moving contact line problem SERAFIM KALLIADASIS, Department of Chemical Engineering, Imperial College — At the heart of the problem is its multiscale nature: a nanoscale region close to the solid boundary where the continuum hypothesis breaks down must be resolved before phenomenological macroscale parameters such as contact line friction and slip, often adopted to alleviate the singularity, can be obtained. Here we will review recent progress made by our group to rigorously analyse the moving contact line problem and related physics from the nano- to macroscopic lengthscales. Specifically, to capture nanoscale properties and to establish a link to the macroscale behaviour, we employ elements from the statistical mechanics of classical fluids, namely density-functional theory (DFT). We formulate a new and general dynamic DFT (DDFT) which is coupled to hydrodynamics and we refer to as "hydrodynamic DDFT". It is inherently multiscale bridging the micro- to the macroscale and retaining the relevant fundamental microscopic information (fluid temperature, fluid-fluid and wall-fluid interactions) at the macroscopic level. Work analysing the contact line in both equilibrium and dynamics will be presented. Hydrodynamic DDFT allows us to benchmark existing phenomenological models and reproduce some of their key ingredients. But its multiscale nature also enables us to unravel the underlying physics of the moving contact line, not possible with any of the previous approaches, and indeed show that the physics is much more intricate than the previous models suggest.

Serafim Kalliadasis
Department of Chemical Engineering, Imperial College

Date submitted: 31 Jul 2019 Electronic form version 1.4