MACROSCOPIC PHASE FIELD MODEL OF PARTIAL WETTING IN CONFINED GEOMETRIES: FROM CAPILLARIES TO POROUS MEDIA

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Drops and bubbles are non-spreading, local, compactly supported features. They are also equilibrium configurations in partial wetting phenomena. Yet macroscopic theories of capillary-dominated flow are often unable to describe these systems. We propose a framework to model multiphase flow in porous media with non-spreading equilibrium solutions. We illustrate our approach with a one-dimensional model of two-phase flow in a capillary tube. Our model allows for the presence of compactons: non-spreading steady-state solutions in the absence of external forces. We show that local rate-dependency is not needed to explain globally rate-dependent displacement patterns, and interpret dynamic wetting transitions as the route from equilibrium, capillary-dominated configurations, towards viscous-dominated flow. Mathematically, these transitions are possible due to non-classical shock solutions and the role of bistability and higher-order terms in our model.