Spreading phenomena under singular potentials: statics and dynamics

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We look at spreading phenomena under the action of singular potentials modelling repulsion between the liquid-gas interface and the substrate. We mainly discuss the static case: depending on the form of the potential, the macroscopic profile of equilibrium configurations can be either droplet-like or pancake-like, with a transition profile between the two at zero spreading coefficient. These results generalize, complete, and give mathematical rigor to de Gennes' formal discussion of spreading equilibria. Uniqueness and non-uniqueness phenomena are also discussed. Then we will briefly focus on the dynamics, assuming zero slippage at the contact line. Based on formal analysis arguments, we report that generic travelling-wave solutions exist and have finite rate of dissipation, indicating that singular potentials stand as an alternative solution to the contact-line paradox. In agreement with equilibrium configurations, travelling-wave solutions have microscopic contact angle equal to $\pi/2$ and, for mild singularities, finite energy.

This is a joint work with Lorenzo Giacomelli.