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Study of the $(1+1)$D Long Wavelength Steady States of the Bénard Problem For Ultrathin Films CHENGZHE ZHOU, SANDRA TROIAN, California Institute of Technology, 1200 E California Blvd., MC 128-95, Pasadena, CA — We investigate the stationary states of the $(1+1)$D equation $h_t + \left[h^3 h_{xxx} + h^2 \gamma_x(h)\right]_x = 0$ for thin films of thickness $h(x,t)$ where x is the spatial variable and t is time. The variable $\gamma(h)$, denotes the surface tension along the gas/liquid interface of the slender bilayer confined between two substrates enforcing thermal conduction within the gap. Equilibrium solutions include flat films, droplets, trenches/ridges and positive periodic steady states (PPSS), the latter conveniently parameterized by a generalized interfacial pressure and the global extremum in shape. We derive perturbative solutions describing PPSS shapes near the stability threshold including their minimal period, average height and free energy. Weakly nonlinear analysis confirms that flat films always undergo a supercritical unstable pitch-fork bifurcation. Globally, our numerical simulations indicate at most one non-trivial PPSS per given period and volume. The free energy of droplet states is also always lower than the relevant corresponding PPSS, suggesting that initial flat films tend to redistribute mass into droplet-like configurations. By solving the linearized eigenvalue problem, we also confirm the unstable nature of PPSS solutions far from the stability threshold.

Sandra Troian
California Institute of Technology, 1200 E California Blvd., MC 128-95, Pasadena, CA

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