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Lie Group Reduction Analysis of the Moving Boundary Problem Governing Benard-Like Fluctuations in Nanofilms ZACHARY NICOLAOU, SANDRA TROIAN, California Institute of Technology, Pasadena, CA — The underlying mechanism responsible for the spontaneous formation of nanopillar arrays in thin viscous films whose free surface is subject to a large transverse thermal gradient continues to be debated. Recent experimental measurements by our group strongly suggest that thermocapillary forces play a central role in the formation and growth of these 3D periodic structures, in a process somewhat akin to the conventional Benard problem. Here we present both analytic and numerical results of the governing thin film equation in the long wavelength approximation for films of constant viscosity subject to capillary and thermocapillary forces. We focus on exact reductions of the highly nonlinear, fourth order equation of motion which reveal steady state solutions, similarity solutions, and other reductions obtained through Lie group analysis. In particular, we predict the possibility of solutions describing isolated droplet formation well beyond the linearized regime. A linear stability analysis of these solutions has been carried out numerically and relevant bounds on droplet stability obtained within restricted parameter regimes. Experimental realization of such isolated droplet formations may find use in scientific and industrial applications such as nanolenses or other optical components.

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