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Contact-line dynamics, bifurcation and bi-stability of droplets driven by thermal gradients JOSHUA BOSTWICK, MICHAEL SHEARER, KAREN DANIELS, North Carolina State University — We consider the quasi-static spreading of a sessile drop on a radially-heated, partially-wetting substrate. In general, for a non-thermally simple fluid, this type of heating can generate both axial and radial temperature gradients along the drop interface, which produce thermocapillary forces. These generate flows that affect the spreading process through the contact-line dynamics. Our model employs lubrication theory together with a constitutive law that relates contact-angle to contact-line speed. We identify parameter regimes in which the droplets continue to spread indefinitely, and compute spreading exponents. In regions of parameter space in which the droplets converge to an equilibrium shape, we show that competition between surface chemistry (wetting conditions) and flow induced by thermal gradients can give rise to bi-stability. The path to equilibrium is then typically complex and the droplet may evolve through a number of intermediate states, such as a capillary ridge or a shape whose bulk and contact-line regions have essentially de-coupled.

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