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Bubble contraction in free-boundary Hele–Shaw flow with surface tension and kinetic undercooling regularisation MICHAEL DALLASTON, SCOTT MCCUE, Queensland University of Technology — When an inviscid bubble expands into a viscous fluid in a Hele-Shaw cell, the bubble boundary is unstable, in general forming long fingers (the Saffman–Taylor instability). In order to make the problem well-posed, a regularising boundary effect must be included. The most widely studied of these are surface tension, which penalises high curvatures, and kinetic undercooling, which penalises high velocities. Both these effects act as a stabilising influence on the free boundary. Less attention has been paid to the case of contracting bubbles, which shrink to a single point (or points) in finite time. In this case, the two effects are in competition, as surface tension stabilises the boundary, while kinetic undercooling destabilises it. This leads to bifurcation behaviour in the asymptotic (near-extinction) shape of the bubble as the relative strengths of the two effects are varied. In particular, there is a critical range of parameter values for which both circular and slit-type bubbles are stable, with a third (unstable) oval-type shape also present. We discuss some numerical and analytic techniques for solving the full free boundary problem and for exploring this interesting extinction behaviour.

Michael Dallaston
Queensland University of Technology

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