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Saddle-point dynamics in bubble break-up LIPENG LAI, WENDY W. ZHANG, University of Chicago — Cylindrically-symmetric bubble break-up are unstable against azimuthal perturbations. While most perturbations preempt the symmetric pinch-off singularity by creating a smooth contact, our simulations also show a qualitatively different, non-monotonic evolution for certain narrow ranges of initial conditions. To explore this novel behavior, we simulate the break-up of a bubble in 2D in the presence of an $n = 2$ Fourier mode distortion. For this choice of the initial perturbation, the non-monotonic shape evolution proceeds as follows: the neck cross-section collapses into a narrow and long slot shape. The two ends of the "slot" initially sharpen rapidly. Then the sharpening slows. Eventually the curvatures of the two ends invert, creating two narrow fingers of water that intrude into the bubble interior. As time goes on, the tip of the intrusion broadens while the finger remains relatively narrow, causing the entire intrusion font to resemble a mushroom on a thin stalk. This sharpen-first-then-broaden sequence is qualitatively consistent with a phase space trajectory controlled by the presence of a saddle point. The maximum end curvature attained during the time evolution appears to diverge as the amplitude or the phase of the initial Fourier mode distortion is tuned towards appropriate threshold values. This suggests that the saddle corresponds to a singular interface shape.

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