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Asymmetric bubble collapse LIPENG LAI, KONSTANTIN S. TURITSYN, WENDY W. ZHANG, University of Chicago — Recent studies reveal that an inertial implosion, analogous to the collapse of a large cavity in water, governs how a submerged air bubble disconnects from a nozzle. For the bubble, slight asymmetries in the initial neck shape give rise to vibrations that grow pronounced over time. These results motivate our study of the final stage of asymmetric cavity collapse. We are particularly interested in the generic situation where the initial condition is sufficiently well-focused that a cavity can implode inwards energetically. Yet, because the initial condition is not perfectly symmetric, the implosion fails to condense all the energy. We consider cavity shapes in the slender-body limit, for which the collapse dynamics is quasi two-dimensional. In this limit, each cross-section of the cavity evolves as if it were a distorted void immersed in an inviscid and irrotational fluid. Simulations of a circular void distorted by an elongation-compression vibrational mode reveal that a variety of outcomes are possible in the 2D problem. Opposing sides of the void surface can curve inwards and contact smoothly in a finite amount of time. Depending on the phase of the vibration excited, the contact can be either north-south or east-west. Phase values that lie in the transition zone from one orientation to the other give rise to final shapes with large lengthscale separation. We show also that the final outcome varies non-monotonically with the initial amplitude of the vibrational mode.

Wendy W. Zhang
University of Chicago

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