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Bubble pinch-off in turbulence: shape oscillations and escaping self-similarity[1] DANIEL RUTH, WOUTER MOSTERT, STPHANE PERRARD, LUC DEIKE, Princeton University — Though bubble pinch-off is an archetype of a dynamical system evolving towards a singularity, it has always been described in idealized theoretical and experimental conditions. Using experiments, simulations, and analytical modeling, we consider bubble pinch-off in a turbulent flow, representative of natural conditions in the presence of strong and random perturbations. We show that the turbulence sets the initial conditions for pinch-off, but once the pinch-off starts, the turbulent time at the neck scale becomes much slower than the pinching dynamics: the turbulence freezes. We show that the average neck size, $\overline{d}$, can be described by $\overline{d} \sim (t - t_0)^\alpha$, where t_0 is the pinch-off, or singularity time, and $\alpha \approx 0.5$, in close agreement with the axisymmetric theory with zero initial flow. Neck shape oscillations set by the initial conditions are described by a quasi-two-dimensional linear perturbation model, and persistent asymmetries in the neck are related to the complex flow field induced by the deformed bubble shape. In many cases, a three-dimensional kink-like structure forms on part of the neck just before pinch-off, causing $\overline{d}$ to escape its self-similar decrease.

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