

---

# Deformation and stability of a gas bubble in a biaxial straining flow

Aliénor Rivière<sup>\*1</sup>, David Fabre<sup>2</sup>, Jacques Magnaudet<sup>3</sup>, and François Gallaire<sup>1</sup>

<sup>1</sup>LFMI, EPFL – Suisse

<sup>2</sup>IMFT – Université Paul Sabatier-Toulouse III - UPS – France

<sup>3</sup>Institut de mécanique des fluides de Toulouse – Centre National de la Recherche Scientifique, Institut National Polytechnique (Toulouse), Université de Toulouse – France

## Résumé

Taking advantage of the recently developed L-ALE framework (Sierra-Ausin et al., *Phys. Rev. Fluids* 7, 113603 (2022)), we characterize the linear dynamics of an incompressible gas bubble immersed in a biaxial straining flow. We show that the system undergoes a saddle-node bifurcation with strongly different equilibrium shapes when varying the Ohnesorge number,  $Oh$ , which compares viscous and capillary effects. Equilibrium shapes are found to be oblate for sufficiently large  $Oh$  while, counter-intuitively, they are prolate for low-enough  $Oh$ . The bifurcation diagram is found to contain also two sets of disconnected branches that cannot be obtained by continuation starting from a spherical shape. One set corresponds to bubble shapes expected to be unstable, while the second set comprises a wide region exhibiting stable shapes that might be observed experimentally. We then characterize the linear stability of the various branches. In addition to the unstable axisymmetric mode arising at the saddle-node bifurcation, two non-oscillating drift modes are also identified, together with two new unstable modes with azimuthal wave number  $m=2$  and two oscillating modes of wave numbers  $m=3$  appearing for  $We > 11$ . Present results lead to conclusions that may be relevant in the context of bubble breakup. In particular, they show that bubbles are much more stable in the biaxial flow geometry than in the uniaxial one. This presumably explains why turbulent breakup mostly happens in uniaxial regions, although biaxial regions are significantly more frequent.

---

<sup>\*</sup>Intervenant