

Talks

Singularities in a glass of champagne

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Speaker

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When a bubble bursts at a liquid surface, like the ones in a glass of champagne, capillary waves travel along its cavity and can focus the flow into a thin, fast Worthington jet. Although surface tension initiates this motion, the singular dynamics near jet inception are governed solely by inertia. Using direct numerical simulations and reduced-order theory, we show how the conical cavity selects a family of self-similar solutions whose exponents depend on the cone angle. The dynamics near the singularity are self-similar but not universal. For the bursting bubble geometries that I will discuss in this talk, the self-similarity exponents lie close to the classical $2/3$ value, but the local Weber number diverges as the jet radius shrinks, revealing a purely inertial force balance. Viscosity helps select the cavity geometry through capillary-wave damping. For micron-sized water bubbles, the expected regularization from viscous stresses only happen at nanometric scales where the continuum description may no longer apply [1].

We then ask how other features could regularize this singularity. For example, how this singular focusing changes when the liquid can sustain elastic stresses or resist flow below a yield stress. We show that yield stress can completely arrest cavity collapse, leaving a residual crater and suppressing jet formation [2]. Elastic stresses can also alter jet growth and breakup, allowing a jet to form without ejecting droplets [3]. In elastoviscoplastic liquids, elastic stress relaxation modifies the effect of yield stress, and jet development depends non-monotonically on the relaxation time [4]. Droplet ejection can thus be suppressed before a jet forms, by arresting cavity collapse, or after it forms, by preventing pinch-off.

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Videos

Singularities in a glass of champagne

[Bubble bursting and Worthington jet formation](#)

Video: Arup K. Das and Thomas Séon, Institut d'Alembert, Sorbonne Université. Ghabache et al., *Scientific Reports* **6**, 25148 (2016). [Original slide](#).

Bursting bubbles in a non-Newtonian medium

[Mud pots, Yellowstone National Park](#)

Mud pots in Yellowstone National Park. [Watch on YouTube](#) · [Original slide](#).

References

- [1] J. M. Gordillo, J. Rodríguez-Rodríguez, and V. Sanjay, “Self-similar Worthington jets,” *arXiv:2607.08972*, 2026. Preprint.
- [2] V. Sanjay, D. Lohse, and M. Jalaal, “Bursting bubble in a viscoplastic medium,” *J. Fluid Mech.*, vol. 922, A2, 2021. doi:10.1017/jfm.2021.489.
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