Fluid Pinch-off from Superfluid Helium to Flatland

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The breakup of fluid droplets has been a popular subject of scientific research because of it's ubiquity in nature and ease of experimental access. This "pinch-off" event represents a topological transition which is characterized by a finite-time singularity in the flow where pressures and velocities diverge and length scales shrink to zero. Singularities in these systems often display "self-similarity", where a phenomenon reproduces its structure and geometry at different length and/or time scales. My work has explored pinch-off in a number of unique systems including liquid mercury, high-pressure bubbles, superfluid helium, and quasi-2D oil puddles on water. This talk will discuss some experiments and numerical simulations that illustrate how the self-similar behavior depends on the physical properties of the fluid and the dimensionality of the system (i.e. 3D vs. 2D). The focus will mainly be non-viscous fluids (i.e. water) where I will illustrate the difference between "self-similarity of the first kind" in 3D and "self-similarity of the second kind" in 2D, the latter of which is characterized by non-isotropic, irrational scaling exponent