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Instability of floating extensional flows ROIY SAYAG, Ben-Gurion University, Dept. of Environmental Physics, GRAE WORSTER, University of Cambridge, DAMTP — We study the propagation of a viscous fluid over a thin layer of a denser and inviscid fluid. The viscous fluid is released axisymmetrially at constant flux, and is driven by gravity. Near the origin, where the viscous layer is thick, the flow is dominated by vertical shear. In the outer region where the viscous layer is thinner, it floats over the inviscid layer and the dominant stress is extensional. The floating region of such flows remains axisymmetric when the viscous fluid is Newtonian. In contrast, when the viscous fluid is non Newtonian, the floating region can be distributed in an array of extensional tongues. We use experimental and theoretical analysis to study the symmetry breaking of the extensional region. Experiments using polymeric fluids show that the characteristic wavelength of the tongues increases with flux. Theoretically, we model the symmetry breaking as flow instability of a power-law fluid that becomes Newtonian at low strain rates. Our model predicts unstable modes at the strongly non-Newtonian limit, and stable, axisymmetric mode in the Newtonian limit.

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